Decisions Under Uncertainty

ECON 171, Summer Session II, 2025.

University of California San Diego.

Letter to the Student

Dear student,

Welcome to Econ 171. Economics is all about decision-making, as you learned in Econ 100A. But unlike the problems you studied there, life is full of uncertainty. We often make choices without knowing exactly what will happen. How do economists think about these scenarios? In this episode of your college adventure, we'll explore how people perceive, weigh, and manage risks—and how they make trade-offs under uncertainty. Along the way, we'll build a toolkit that includes decision trees, expected utility, risk preferences, insurance, and portfolio theory, and we'll ask where these models work—and where they don't. To get the most out of the course, you should have completed Econ 100A and Econ 120A (or an equivalent statistics course).

Class meetings

Lectures: Tuesday and Thursday 5:00pm-7:50pm (typically 5-7:10), Cognitive Science Building #004.

Discussion Sessions: Wednesday 4:00pm-5:50pm, on Zoom. (https://ucsd.zoom.us/j/97979655515)

Lectures will be in person only. Discussion will be recorded and made available on Canvas.

Teaching Team:

Instructor: My name is Jordi Martinez Muñoz (jom001@ucsd.edu). I'm a 6th-year PhD candidate in Economics. My research interests include behavioral and experimental economics, and I am currently working on a project investigating the exploration-exploitation trade off. You can talk to me at the end of each lecture or during my office hours:

- **Thursdays, 3:30pm-4:30pm**, Atkinson Hall #3803
- **Fridays, 6:00 pm – 7:00 pm** on Zoom (https://ucsd.zoom.us/j/8087766712)

TA: Doyoung Song (dos006@ucsd.edu). Office hours: Wednesdays 3pm to 4pm, on Zoom (https://ucsd.zoom.us/j/97979655515)

Communication protocol: The official channels for material-related questions are lectures, discussion sessions, and office hours. Additionally, there is a discussion panel available on Canvas under the Discussion tab. Please reserve email communication for urgent

administrative matters only. This approach helps with fairness, quality, and efficiency in our interactions. We will reply as soon as we can, but please be patient.

Class materials

Lectures: Your main source of information. Here, you'll have the opportunity (and are encouraged) to ask questions, clarify doubts, and engage with the material through various activities.

Lecture notes (handouts): A written version of the lectures.

Books: Books are supplements to the lectures and lecture notes. The recommended book is *Petersen (2017). An Introduction to Decision Theory, Cambridge University Press; 2nd edition.* (Not provided through Canvas). I will not necessarily follow this book.

Intermediate Microeconomics Video Handbook (IMVH): A set of videos created by the Economics Department at UCSD. I highly recommend you check them out!

TA Sessions and Office Hours: Weekly discussion sessions to review the class material and practice problem-solving. The TA and I will also offer office hours to support your learning process (see above).

Discussion board on Canvas: This is a great place to ask questions, share insights, and collaborate with your peers. We will monitor it often.

Organization of the class

This journey is divided into a minimum of 7 chapters (with 2 more optional conditional on time allowing). My goal as an instructor is for you to achieve certain skills and capabilities by the end of each chapter. Below is the map of this class.

Chapter 1: Introduction to Decisions Under Uncertainty. What is the problem of decision-making under uncertainty? How can we represent uncertain situations?

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

- Define and distinguish between different types of environments that lack certainty: objective risk, subjective risk, and uncertainty.
- Identify the key components of a decision problem under uncertainty: actions, states, outcomes, and probabilities. Define mutual exclusivity and collective exhaustivity.
- Apply decision trees and payoff matrices to represent a variety of decision problems under uncertainty, including less structured, real-world situations.
- Analyze the relationship between this framework and the practical principles of risk management.

Chapter 2: Decision Criteria. How can we represent uncertainty using random variables? How can we decide what to do when facing uncertainty?

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

- Represent uncertainty through random variables and compute their key properties
- Compute expected values within a decision tree.
- Define and apply different non-probabilistic decision criteria:
    - Maximax
    - Maximin
    - Minimax regret
- Define and apply different probabilistic decision criteria:
    - Expected value
    - Mean-variance
    - First order stochastic dominance
    - Expected Utility (chapter 4)

Chapter 3: Complex choices (compounded and conditional choices). How do we handle uncertainty when choices involve multiple stages or layers of uncertainty?

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

- Compute the expected value of actions when states are compounded.
- Apply backward induction to solve decision problems with sequential actions and represent them in decision trees.

Chapter 4: Expected Utility. How does the concept of utility from microeconomic theory apply to decisions under uncertainty?

By the end of this chapter, you will:

- Define the expected utility criterion (for objective lotteries) and explain its advantages over the expected value criterion.
- Describe the properties of the expected utility function: linear in probabilities and increasing (although it may be nonlinear) in outcomes.

- Explain and identify the axioms of expected utility theory: completeness, transitivity, independence, and mixture continuity. Only completeness and transitivity will be tested.

Chapter 5: Risk Preferences. How can we characterize and identify the different attitudes towards risk?

By the end of this chapter, you will:

- Use the formal definition, graphical representation, and second derivative criterion to identify convex, linear, and concave functions.
- Define attitudes toward risk: risk-aversion, risk-neutrality, and risk-loving. Identify them through the shape of the utility function, and through revealed preferences (choices).
- Define and compute the certainty equivalent and risk premium and use them to characterize and compare risk preferences.
- Analyze how risk aversion changes with wealth and stake size, using the concepts of absolute and relative risk aversion.

Chapter 6: Insurance. How do insurance markets work? What is the good, the bad, and the ugly about them?

By the end of this chapter, you will:

- Model the fundamentals of insurance demand and supply using utility functions, certainty equivalents, and expected profits. Define and interpret actuarially fair premiums.
- Identify and interpret the structure of insurance contracts, using real-life examples to link theory to practice.
- Critically assess the functioning of private insurance markets in terms of efficiency and equity, including the roles of market power, moral hazard, and adverse selection. Analyze the role of social insurance as an alternative to private insurance.

Chapter 7: Riskier Lotteries. Can we compare the level of risk of different lotteries beyond the variance?

By the end of this chapter, you will:

- Define the “riskier” comparison criterion for lotteries based on the choices of a risk-averse decision maker.
- Define, identify, and compute mean preserving spreads of lotteries, and relate it to the classification of riskier lotteries.

- Apply the SOSD criterion to identify riskier lotteries. Identify some of its necessary and sufficient conditions.

- Evaluate insurance contracts using dominance criteria (FOSD and SOSD), and interpret empirical findings on how individuals choose among insurance options.

Chapter 8: Applications to Finance (Optional and Conditional on timing). How can concepts of risk and uncertainty be applied to financial decisions?

By the end of this chapter, you will:

- Define key financial terms: assets, stocks, portfolio, capitalization, etc.

- Compute the expected value and volatility of individual assets and portfolios.

- Describe the variance-minimization problem and the mean-variance criterion in portfolio selection. Solve variance-minimization problems for two assets.

- Explain the main assumptions and implications of Modern Portfolio Theory and Capital Asset Pricing Model (CAPM).

Chapter 9: Empirical evidence on Expected Utility Theory and alternative theories *(Optional and Conditional on timing)..* What does empirical evidence say about the validity of expected utility to predict behavior? What other alternative theories have been proposed?

By the end of this chapter, you will:

- Describe key empirical anomalies relative to expected utility theory.

- Explain the main ideas of prospect theory and how it differs from expected utility theory.

- Reflect on the validity of expected utility theory as a normative versus positive model of behavior.

How will I assess your progress in this class?

The evaluation will consist of six items: One midterm exam, one final exam, quizzes, homework, participation, and a short presentation.

Participation	*20%*
Quizzes	*5%*
Homework	*15%*
Presentation	*15%*
Midterm Exam	*20%*
Final Exam	*25%*
Total	*100%*

Participation, 20%. Every lecture, there will be in class practice and exercises to reinforce the material. Attending to these, counts as participation. In addition, sometimes I will ask you to answer a reflection question on Canvas about how you feel about the material/lectures in terms of difficulty and interest. If you miss these activities, they cannot be made up, but you only need to complete 90% of them to receive full credit.

Quizzes, 5%. At the end of each class, you'll take a short quiz (one or two multiple-choice questions). Expect one every class, though I may skip some. If you miss a quiz, it cannot be made up, but your two lowest quiz grades will be dropped. Additionally, if any of your exam grades is higher than your average quiz grade, your quiz grade will be replaced by your exam grade (but not the other way around).

Homework, 15%. Homework consists of short assignments to help you stay engaged with the material between classes. You can submit late homework up to two weeks after the due date for up to 70% credit; after that, the grade will be zero. Detailed instructions will be provided with each assignment. Expect one or two assignments per week.

Presentation, 15%. In weeks 4 or 5, you will give a 10-minute presentation on an application of the course material to a topic that interests you. Based on your responses to the first homework assignment, I'll assign you a short reading (usually the introduction and one other section of an academic paper). You'll prepare a couple of slides to share with the class. The grading criterion will be provided by the end of week 2. This assignment has three goals: 1) To get you comfortable presenting in front of an audience 2) To help you connect the course content with topics you care about, and 3) To contribute to the collective class knowledge about applications of the class content. **The presentation is optional**: If you choose not to present, the 15% will automatically apply to the final exam. You have time up to week 4 to decide if you want to present.

Problem Sets 0%. Weekly problem sets will be available for practice, but they are not for submission. They are designed to help you prepare for exams and reinforce key concepts.

Midterm exam, 20%. The midterm exam will take place during the first 70 minutes of the lecture on August 21. If you miss the midterm, the 20% will be added to your final exam, making it worth 45% of your grade. I do not recommend missing the midterm unless absolutely necessary. You don't need to present any justification if you miss the midterm. There will be no make-up exam and no exceptions. The midterm covers content from the first four lectures. If your final exam grade is greater than your midterm exam grade, then the final exam grade will substitute the midterm exam grade (the other way around is not possible).

Final exam, 25%. The final exam will cover all the material discussed in class.

Regrading policy: You can request a regrade within seven days of receiving your grade. Please revise the grading rubric carefully before submitting a regrade request.

Some useful information about the exams:

Both the midterm and final exams will include multiple-choice, fill-in-the-blank, short answer, and analytical problem-solving questions. The in-class activities, and quizzes are designed to help you prepare for the exams. The exams are **open book / open notes**, but **only physical notes**

will be allowed (no phones, laptops, tablets, smartwatches, or other technological devices, , except calculators). A strong grasp of the material is essential; trying to "look up" answers during the exam may not be effective.

Important dates:

Drop without a "W" Deadline: August 15.

Midterm Exam: August 21, in class (first 70 minutes).

Drop with a "W" Deadline: August 22.

Final Exam: September 6, 7:00pm-9:50pm, place TBA.

Tentative schedule of topics

We have 10 sessions of 3 hours each. This is a tentative plan of how topics will be distributed among the classes:

Session	Topic
Session 1, Aug 5	Introduction, Chapter 1
Session 2, Aug 7	Chapter 2
Session 3, Aug 12	Chapter 2 - Chapter 3
Session 4, Aug 14	Chapter 3 – Chapter 4
Session 5, Aug 19	Midterm Review - Chapter 5
Session 6, Aug 21	**Midterm (covers up to session 4) –** Chapter 6
Session 7, Aug 26	Chapter 7
Session 8, Aug 28	Chapter 7 – Chapter 8 – Presentations
Session 9, Sept 2	Chapter 8 – Chapter 9 – Presentations
Session 10, Sept 4	Chapter 9 -Final Review - Presentations

Other

Disability Accommodations. Campus policy regarding disabilities requires that faculty adhere to the recommendations of the Office for Students with Disabilities (OSD). Any student eligible for and needing academic adjustments or accommodations because of disability should submit to me a letter from OSD describing appropriate adjustments or accommodations and should arrange to meet with me as soon as possible so that arrangements can be made in a timely manner. University policies regarding disabilities are available at http://disabilities.ucsd.edu/students/. Appointments with OSD (phone or in-person) can be made by calling 858.534.4382 or by email at osd@ucsd.edu. More information can also be found here.

Academic Integrity. Students who violate UCSD's academic integrity policy will earn a failing grade for the course. In addition, the Council of Deans of Student Affairs will impose a disciplinary penalty.

Religious Observance. Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly accommodate all students who, because of religious obligations, have conflict with scheduled examinations, assignments or required attendance. Please, let me know about a potential conflict as soon as possible so that we can reschedule the relevant assignment/examination.

Harassment Policy. The University Policy on Discrimination and Harassment applies to all students, staff and faculty. Any student, staff member or faculty member who believes that they have been the subject of discrimination or harassment based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy, should contact the Office for the Prevention of Harassment and Discrimination (OPHD) at (858) 534-8298, ophd@ucsd.edu, or reportbias.ucsd.edu.

Data Privacy. The University adheres to the standards for student privacy rights and requirements as stipulated in the Federal Rights and Privacy Act (FERPA) of 1974, see http://ucsd.edu/catalog/front/ferpa.html.

Health and Well-Being. Throughout your time at UC San Diego, you may experience a range of issues that can negatively impact your learning. These may include physical illness, housing or food insecurity, strained relationships, loss of motivation, depression, anxiety, high levels of stress, alcohol and drug problems, feeling down, interpersonal or sexual violence, or grief. These concerns or stressful events may lead to diminished academic performance and affect your ability to participate in day-to-day activities. If there are issues related to coursework that are a source of particular stress or challenge, please speak with me, so that I am able to support you. UC San Diego provides a number of resources to all enrolled students, including:

- *Counseling and Psychological Services (858-534-3755 — caps.ucsd.edu)*
- *Student Health Services (858-534-3300 — studenthealth.ucsd.edu)*
- *CARE at the Sexual Assault Resource Center (858-534-5793 — care.ucsd.edu)*
- *The Hub Basic Needs Center (858-246-2632 — basicneeds.ucsd.edu)*

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I hope you enjoy this class!

Jordi