# Decisions, Games, and Social Choice

George Mason University, Spring 2018

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| **Office Hours** | TR 1:30-2:30 PM |

# Prerequisites

While no prior knowledge of decision/game/social choice theory is required, you should be somewhat familiar with mathematical formalism, probability, and basic proof methods.

# Readings

The following texts should be purchased from the campus bookstore:

- Martin Peterson. *An Introduction to Decision Theory*. 2nd Ed. Cambridge University Press, New York, 2017.
- OPTIONAL Michael D. Resnik. *Choices: An Introduction to Decision Theory*. University of Minnesota Press, Minneapolis, 1987.

The other required texts are linked to from the reading schedule, which you can find at http://tomwilk.net/phil411/.

# Schedule

## 1. Decision Theory

# Schedule

## 2. Game Theory

# Schedule

## 3. Social Choice Theory

# Requirements

There are four requirements for taking this course:

- Participation & Attendance (5% of final grade)
- Exercise sets (30% of final grade)
- Midterm exam on Mar 8 (30% of final grade)
- Final exam on May 10 (35% of final grade)

# Academic Integrity

Please do not cheat. This would be depressing. Cheating hurts the George Mason community by undermining academic and personal integrity, creating mistrust, and fostering unfair competition. Ethical violations include cribbing on exams, plagiarism, reuse of assignments, improper use of the internet and electronic devices, unauthorized collaboration, and alteration of graded assignments. Cheaters may receive a grade of F in the course and can face more dire consequences in extreme cases. Plus, it makes me very sad.

Report any violations you happen to witness to me.

# Disability Accommodations

If you are a student with a disability or believe that you might have a disability that requires special accommodations, please contact Disability Services to obtain an accommodation letter from a specialist: $http : //ds.gmu.edu/$.

# Counseling Services

Should you need counseling services or just need someone to listen, please know that the Counseling and Psychological Services office is here to provide emotional support and assistance for your mental health needs as you make your way through your time at Mason. Call: (703) 993-2380 or visit `https://caps.gmu.edu/`.

# Decisions, Games, and Social Choices

- **Decision Theory** aims to model individual choices in an uncertain world with imperfect information.

- **Game Theory** aims to model choices made when two or more decision-makers interact in a way that potentially affects the outcomes they will realize.

- **Social Choice Theory** aims to model the way individual preferences of a heterogeneous group are amalgamated into a single social preference ordering.

# Decision Theory

Let's start with some examples.

- What kind of decisions have you made today?
- What did you think about when you made those decisions?
- What kinds of factors affected the outcome of those decisions?

# Decision Theory

- An individual must choose between two or more actions.
- The outcome of each act depends on the state of the individual's external environment.
- The individual might be completely ignorant or quite knowledgable about the environment.
- The individual has preferences over the set of outcomes.
- The individual has a particular risk profile.

# Decision Theory

- **Descriptive Decision Theory:** The study of how decisions are actually made by us ordinary mortals with our limited cognitive resources, biases, and other psychological deficiencies.

- **Normative/Evaluative Decision Theory:** The study of what choices *ought* to be made or how decisions *should* be made— that is, the study of decision making by ideal *rational* agents.

# Decision Theory

**Ex.** Oysters.

Driving along a desolate stretch of the Pacific coast, you stop at a small wooden shack by the side of the road with an 'Oysters' sign. Inside, an old man is selling both raw and grilled oysters. You are very hungry, and you prefer eating a fresh raw oyster to a grilled one. But you'd rather eat nothing than eat a spoiled oyster and get sick. Do you eat raw oysters, grilled oysters, or do you just continue down the road?

# Decision Theory

**Ex.** Pharmaceutical Company.

You are the CEO of a pharmaceutical company that has developed an insomnia drug which just received FDA approval. However, there is a 10% probability that the drug has bad side effects that were not detected in the FDA trials, and you are considering whether to run an additional $1M test to find out if the drug has these effects (should the test reveal the bad side effects, you will not market the drug as planned). If you market the drug and there are no problems, then you stand to make $5M in sales. But if you market the drug without further testing and it has problems, then you stand to lose $15M. Do you run the test?

# Decision Theory

**Ex.** Love vs. Work.

You are a graduate student at the University of Wisconsin and have been offered a tenure-track faculty position at Yale, but your romantic partner must remain in Madison for work and is not willing to do long-distance. Your post-graduate job prospects in Madison are not very promising but they might improve in a year or two. Do you take the job at Yale or stay with your partner in Madison?

# Decision Theory

**Ex.** St. Petersburg Game (Bernoulli).

You are given a choice between the following two payouts:

A: $100.

B: A fair coin is flipped until it lands tails. If the coin lands tails on the first toss, then you receive $2. If the coin lands tails on the second toss, then you receive $4. In general, if the coin lands tails on the $n$th toss, then you receive $2^n$.

Do you choose A or B?

# Game Theory

- Multiple individuals, or *players*, are engaged in a competitive or cooperative strategic interaction, or *game*.
- Players must choose how to act in pursuit of their own individual objectives.
- These actions might be simultaneously or sequentially performed and agents might have full or only partial information about each others' moves.
- The outcome of the game depends on the actions of all the players (and possibly chance) and each player will take into account their expectations of other players' behavior in deciding how to act.
- Each player has preferences over the set of outcomes.

# Game Theory

**Ex.** Stag Hunt (Rousseau).

You and an acquaintance have gone hunting and you must each decide whether to pursue a large stag or to pursue a small hare. Alone, you can each capture a hare. However, a stag requires two people to capture. If you cooperate and both hunt stag, then you will end up with much meat. But if you hunt stag while your acquaintance hunts hare, then you return home empty-handed. Do you hunt stag or hare?

# Game Theory

**Ex.** Traveller's Dilemma (Basu).

An airline loses your suitcase and the suitcase of your doppelgänger that has the exact same contents. An airline manager separates you and your doppelgänger and asks you both to estimate the value of your lost luggage at no less than $2 and no more than $100 which is the maximum that the airline will reimburse you. If you both write down the same number, then the manager will treat this as the true value of your luggage and reimburse you both this amount. But if you write down different numbers, then the manager will treat the lower number as the true value. Moreover, whichever one of you wrote down the lower number will be awarded $2 extra for your honesty, and whichever one of you wrote down the higher number will have $2 deducted from your payout. What number do you write down?

# Game Theory

**Ex.** Chain-Store Game (Selten).

You own a chain-store with branches in fifty different U.S. cities. In each city, you face a single potential competitor who might encroach on your turf. If a competitor moves in, you can choose to fight or cooperate. Since fighting is costly, you prefer cooperating to fighting in the face of competition, but your favored outcome is when a potential rival does not move in at all. A potential rival is best off when they move in and you cooperate, but they would rather not compete than fight with you. Now suppose that this all plays out sequentially, city after city, and each potential competitor knows what has happened previously. What is your strategy?

# Social Choice Theory

- A heterogeneous group of individuals, or *citizens*, must choose between two or more group actions or policies.
- Each citizen has their own preferences over the set of alternatives and these individual preferences must be amalgamated into a single social preference relation.

# Social Choice Theory

**Ex.** City Council.

The City of Toronto has some extra cash in its municipal budget and the mayor forms a three-person committee to help decide how to spend this money. The options on the table are a new park, a new homeless shelter, and the development of more bike lanes. The committee members have the following preference profiles:

| Member 1 | Member 2 | Member 3 |
| --- | --- | --- |
| Park | Shelter | Bike Lanes |
| Shelter | Bike Lanes | Park |
| Bike Lanes | Park | Shelter |

What group preference relation over the options should the committee submit to the mayor?