

## QTM 511: Reasoning II

Contact Hours: Two 1.25-hour or one 2.5-hour session weekly, plus 4.5 hours of regular, out-of-class work required as preparation for in-class work

Credit Hours: 3

Prerequisites: QTM 510

Instructor:	Xxx
Semester	Spring 20xx
Meeting Time and Place:	xxx
Office:	xxx
Office Hours:	xxx
Email/Contact:	xxx
Course Website:	xxx
TA:	xxx

### COURSE OBJECTIVES

This class will provide a framework for using quantitative skills to model the world. An emphasis of the course is a tight interplay between empirical observation about correlations and causal mechanism and the role of theory in interpreting these facts. The course begins by discussing the role of models and theory in the development of knowledge and in making decision at the policy level—where a policy is simply a course of action taken by an individual organization or government. The course then moves into developing models of individual human behavior including classical rational models and Bayesian of preferences and information processing as well as newer psychological and behavioral models of human behavior. We then discuss models of environment (broadly interpreted) before turning to models of group behavior, learning and decision making. In this section, students will be exposed to a modern treatment of networks, social choice, market design and cooperative and noncooperative game theory.

### CLASS REQUIREMENTS

Grades will be based on

- homework assignments (25 %)
- 2 midterm exams (20 % each)
- a final exam (30 %)
- Class Participation (5%)

### HOMEWORK

The homework assignments will consist of 2 analytical problem sets, 1 writing-based problem set and 1 model writing exercise. Each assignment will have its due date indicated and should be submitted through Canvas. Usually it would be due before the class (11:30 am). Any assignment submitted after the due date/time will be considered 0 points. To accommodate unexpected circumstances, your lowest homework grade will be automatically dropped at the end of the semester. Working together on the homework assignments is encouraged, but you must write your own answers. It is highly recommended that you make your solo effort on all the problems before consulting others.

#### Problem Set 1: Writing Assignment

Identify one recent case where a claim is made about a correlation but there is no variation in either the dependent or independent variable. It should come from a news article, academic article, or related source and it should not be any of the examples discussed in class or in the readings. Summarize the argument made and discuss the inferential problem. What alternative analysis could the author have conducted instead to make a more informative comparison? Your write-up should be less than 1,000 words.

## Problem Set 2: Analytic Problem Set

## Problem Set 3: Writing Assignment

We will discuss why comparisons and correlations may not be informative about causal relationships. Find an example of a researcher, journalist, policymaker, etc. who makes an error by wrongly interpreting a correlation as causal. As before, your example should not be closely related to any example discussed in class or in the readings. Explain the evidence presented, and explain why you think this correlation is not informative about the effect of interest. Furthermore, propose an alternative research design that would provide more credible causal evidence on this particular question. Your proposed design should be feasible, meaning that a real researcher or organization with resources (but not endless resources) could actually implement it. Again, your write-up should be no more than 1,000 words.

## EXAMS

The 2 midterms and the final will be in-class exams. **No collaboration is allowed on the exams.**

## Important Dates

Problem Set 1: Week 3

Midterm 1: Week 5

Problem Set 2: Week 7

Midterm 2: Week 10

Problem Set 3: Week 11

Problem Set 4: Week 15

Final: TBD

## HONOR CODE

All students enrolled at Emory are expected to abide by the Emory College Honor Code. Any type of academic misconduct is not allowed which includes 1) receiving or giving information about the content or conduct of an examination knowing that the release of such information is not allowed and 2) plagiarizing, whether intentionally or unintentionally, in any assignment. For the activities that are considered to be academically dishonest, refer to the Honor Code: <http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html>.

## DISABILITY ACCOMMODATIONS

If you are seeking classroom accommodations or academic adjustments under the Americans with Disabilities Act, you are required to register with Office of Accessibility Services (<http://accessibility.emory.edu>). To receive academic accommodations for this class, please obtain the relevant letter and meet with me at the beginning of the semester. Students are expected to give two weeks notice of the need for accommodations.

## REQUIRED TEXTBOOK

- [P] Page, Scott. *The Model Thinker*, Basic Books [W]
- [PMT] Ellenberg, Jordan. 2014. *How Not to Be Wrong: The Power of Mathematical Thinking*. Penguin Books.

## SUPPLEMENTAL TEXTBOOK

- [BBB] Salganik, Matthew. *Bit by bit: Social research in the digital age*. Princeton University Press, 2019.
- As indicated on syllabus. Available on Canvas.

# Part 1: Fundamentals of Models

## Week 1-3

### Topics:

Logic (Refresher)

- Necessary and Sufficient Conditions
- Implications

What is a model?

- Models as simplification
- Models as positive framework
- Models as normative framework [Ethics Component]

Models for Prediction

- Toy Models
- Structural Models

Models for Description

- Normative interpretation of Data
- Positive interpretation of data
- Limits to Prediction for Decision Making Decision Theory

Models for Measurement

- What to measure and why?
- What is measurable and implication for Models
- Quantification and Normative Values [Ethics Component]

Empirical Implication of Theoretical Models Theoretical Implication of Empirical Models

- Comparative statics
- Predictions
- Falsifiability
- Philosophy of Science

Theoretical Implication of Empirical Models

- Interpretation empirical results in light of models
- Limits to research design
- Theoretical Limits to learning

### Reading:

[P], Intro, Chapter 1, 2, 3 and 4

[BBB] Chapter 2

Keane, Michael P. "A structural perspective on the experimentalist school." *Journal of Economic Perspectives* 24, no. 2 (2010): 47-58.

Sims, Christopher A. "But economics is not an experimental science." *Journal of Economic Perspectives* 24, no. 2 (2010): 59-68.

Deaton, Angus. "Instruments, randomization, and learning about development." *Journal of economic literature* 48, no. 2 (2010): 424-55.

Ioannidis, John PA. "Randomized controlled trials: Often flawed, mostly useless, clearly indispensable: A commentary on Deaton and Cartwright." *Social science & medicine* (1982) 210 (2018)

Raudenbush, Stephen W. "On randomized experimentation in education: A commentary on deaton and cartwright, in honor of frederick mosteller." *Social Science & Medicine* 210 (2018): 63-66.

Cartwright, N. (1989). *Nature's Capacities and Their Measurement*. Clarendon Press, Oxford.

Deaton, A. and Cartwright, N. (2017). *Understanding and misunderstanding randomized controlled trials*. *Social Science and Medicine*, in press

Pearl, Judea. "Challenging the hegemony of randomized controlled trials: A commentary on Deaton and Cartwright." *Social Science & Medicine* (2018)

Nevo, Aviv, and Michael D. Whinston. "Taking the dogma out of econometrics: Structural modeling and credible inference." *Journal of Economic Perspectives* 24, no. 2 (2010): 69-82.

Bueno de Mesquita, Ethan, and Scott A. Tyson. *The commensurability problem: Conceptual difficulties in estimating the effect of behavior on behavior*. Working paper, 2019.

## **Part 2: Modelling Individual Decision Makers**

### **Week 4**

#### **Topics:**

Decision Theory for Evaluating Evidence for Policy

- Uncertainty
- Ambiguity
- Bounding
- Planning with partial knowledge
- Optimal experimentation

#### **Reading:**

[P], Chapter 12, 17, 26, 27, 28, 29

Selections from: DeGroot, Morris H. *Optimal statistical decisions*. Vol. 82. John Wiley & Sons, 2005.

Selections from: Manski, Charles F. *Patient Care under Uncertainty*. Princeton University Press, 2019.

Selections from: Manski, Charles F. *Identification for prediction and decision*. Harvard University Press, 2009.

Selections from: Manski, Charles F. *Public policy in an uncertain world: analysis and decisions*. Harvard University Press, 2013.

Selections from: Manski, Charles F. *Social choice with partial knowledge of treatment response*. Princeton University Press, 2005.

### **Week 5-6**

#### **Topics:**

Decision Theory as a Model of Human Behavior

- Rationality
- Reveal Choice
- Uncertainty
- Ambiguity
- Bayesian Updating

Behavioral Economics and Psychological Models of Human Behavior

- Framing
- Heuristics
- Hyperbolic Discounting

#### **Reading:**

Selections from: Kahneman, Daniel. *Thinking, fast and slow*. Macmillan, 2011.

Selections from: Kreps, David. *Notes on the Theory of Choice*. Westview press, 1988.

Selections from: Ariely, Dan. *Predictably irrational*. New York, NY: Harper Audio, 2008.

Selections from: Gilboa, Itzhak. *Theory of decision under uncertainty*. Vol. 45. Cambridge university press, 2009.

Selections from: Gilboa, Itzhak. *Making better decisions: Decision theory in practice*. John Wiley & Sons, 2010.

## **Part 3: Modelling Environments**

### **Week 7**

**Topics:**

## Distribution

- Normality
- Power Laws

## Shapes

- Linearity
- Concavity and Convexities

**Reading:**

[P], Chapter 5, 6, 7 and 8

**Part 4: Modelling Social Behavior****Week 8****Topics:**

## Networks

- Homophily
- Learning and Communicating
- Reflection problem
- Peer Effects
- Contagion
- Diffusion

**Reading:**

[P], Chapter 9, 10 and 11

Selections from: Jackson, Matthew O. *The Human Network: How Your Social Position Determines Your Power, Beliefs, and Behaviors*. Pantheon, 2019.

Selections from: Jackson, Matthew O. *Social and economic networks*. Princeton university press, 2010.

**Week 9****Topics:**

## Group Learning and Investment

- Broadcasting
- Contagion
- Herding
- Path Dependence
- Coordination

**Reading:**

[P], Chapter 13, 14, 15, 18 and 19

**Week 10-11****Topics:**

## Group Decision Making

- Social Choice [Ethics Component]

- Information Aggregation

#### Market Design

- Price Mechanism
- Repugnance [Ethics Component]
- Auctions
- Matching
- Mechanism Design

#### Reading:

[P] Chapter 24

Selections from: Roth, Alvin E. Who gets what—and why: The new economics of matchmaking and market design. Houghton Mifflin Harcourt, 2015.

Selections from: Sen, Amartya. Collective choice and social welfare. Harvard University Press, 2018.

Selections from: <https://www.jeffely.com/post/intermediate-micro-course>

Selections from: Arrow, Kenneth J. Social choice and individual values. Vol. 12. Yale university press, 2012.

Sen, Amartya. 1995. "How to Judge Voting Schemes." *Journal of Economic Perspectives*, 9 (1): 91-98.

Young, Peyton. 1995. "Optimal Voting Rules." *Journal of Economic Perspectives*, 9 (1): 51-64.

Klamer, Arjo. 1989. "A Conversation with Amartya Sen." *Journal of Economic Perspectives*, 3 (1): 135-150.

Roth, Alvin E., and Robert B. Wilson. 2019. "How Market Design Emerged from Game Theory: A Mutual Interview." *Journal of Economic Perspectives*, 33 (3): 118-43.

Coles, Peter, John Cawley, Phillip B. Levine, Muriel Niederle, Alvin E. Roth, and John J. Siegfried. 2010. "The Job Market for New Economists: A Market Design Perspective." *Journal of Economic Perspectives*, 24 (4): 187-206.

Roth, Alvin, E. 2007. "Repugnance as a Constraint on Markets." *Journal of Economic Perspectives*, 21 (3): 37-58.

## Week 12 and 13

#### Topics:

##### Game Theory

- Dominance
- Equilibrium
- Coordination
- Collective Action
- Externalities
- Signaling

#### Reading:

[P] Chapter 21, 22, 23 and 25

Selections from: de Mesquita, Ethan Bueno. *Political economy for public policy*. Princeton University Press, 2016.

## Part 5: Theory and Data

### Week 14

#### Topics:

What's the value of a Model to Data Analysis?

- Exploratory Analysis
- Starting Points
- Organizing Data
- Knowledge

- Disciplining Approach [Ethics Component]

What's the value of Data Analysis for Theory?

- Calibration
- Testing Theory
- Developing new theory

**Week 15: Catch-up and Review**