API-302
ANALYTIC FRAMEWORKS FOR POLICY
Course Information

Where, When:	Lecture: L-280 Tuesday/Thursday, 10:30-11:45 a.m. Review Sections: Friday, 10:30-11:45 a.m., Wexner W-436
Instructor:	Richard Zeckhauser email: richard_zeckhauser@harvard.edu
Secondary Instructor:	Christopher Avery (called on periodically) email: christopher_avery@hks.harvard.edu
Assistant:	Wendy Wyatt email: wendy_wyatt@hks.harvard.edu
Teaching Fellows:	Dan Cadarette (email: dcadarette@hks.harvard.edu) Vidit Doshi (email: vidit_doshi@hks.harvard.edu) Charlie Pozniak (email: cpozniak@hks.harvard.edu)
Office Hours:	Tuesday, 1:00-2:45 p.m.

Course Description

This course develops abilities in using analytic frameworks in the formulation and assessment of public policy. It considers a variety of analytic techniques, particularly those directed toward uncertainty and interactive decision problems. It emphasizes the application of techniques to policy analysis, not on formal derivations. Students are encouraged to work with others on the challenging problem sets. The course employs mini-case studies, methodological readings, the computer, the Internet, and a final exam. Students are pushed to be creative in confronting policy issues.

Content:
- Economics
- Analytic Methods
- Finance
- Game Theory
- Behavioral Economics
- Policy Assessment and Prescription

Prerequisites

- Significant interest in policy issues
- Positive attitude toward using analytic approach to policy issues
- Elementary decision theory (e.g., Howard Raiffa, *Decision Analysis*)
- Comfort with or ability to master mathematical concepts (elementary probability, matrices, calculus—see Math Review section below)
- Acquaintance with analytic models (e.g., Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis*)
- Intermediate level understanding of microeconomics (e.g., Pindyck and Rubinfeld, *Microeconomics*, or Mankiw, *Principles of Microeconomics*
- Intrigued by game theory
- Open minded to new disciplinary approaches
- Moderate Internet appetite
- Diligence
- Inquiring mind
- Sense of humor

Course Requirements

- Regular attendance
- Regular use of name cards
- Active participation in breakout exercises
- Reading assignments to be completed for each class
- Problem of the day when given
- Discussion question of the day, when given. Students will submit responses to discussion questions electronically in advance of class.
- Acceptance of cold calls in class
- Participation in study groups
- Three problem sets
- Participation in class discussion
- Work on the personal computer (includes working with spreadsheets and the Internet)
- Preparation of class notes for classmates
- Very brief paper deploying conceptual tool(s) to address policy issue
- Reading period assignment optional. Nature of assignment not yet determined.

Prerequisites and Course Requirements will be discussed on the first day of class.

Portfolio of Materials and Rationale

Some types of material are best mastered by reading, some through lecture, some through mini-classes on formal techniques, some through independent assignments, and others through working problems. This course seeks to allocate subject areas and methods to the mechanisms that teach them best. (If you understand this approach, you already understand a fundamental principle of optimization.) The consequence is that there is often less overlap among readings, lectures, and problems in this class than you might expect from experience in other classes. Just because a topic is not discussed in class does not mean that it is not important.

In general, particular analytic techniques are taught through readings. The application, justification, and strengths and weaknesses of techniques are more likely to be the subject of in-class instruction and discussion. Structure your expectations and study habits for this course accordingly. If you do not like this "nonlinear" format, this course is not for you.

We make every effort to show that course content is readily applicable to real world events. The best way to do that, we believe, is to discuss recent happenings in light of our conceptual tools. Past examples include COVID-19, the broad-gauge response to the George Floyd murder, and inflation. To illustrate, each of these three earthquake events was the product of a contagion phenomenon. We will discuss new examples for 2024.

The Electoral College will be one salient example for 2024, since the American election will be upon us. A second salient example will be climate change. Unfortunately, that application is sure to be with us for quite a while. No doubt various conflicts around the world will come into discussion, as analytic topics, not moral quandaries. Events during the fall semester, now unforeseen, are sure to make an entry. To be clear, many of the examples utilized for illustration will have minor policy consequences, but will impart general lessons.

Relating our tools to consequential current or recent events enables us to avoid (for the most part) any accusation that heavy selection bias influenced our applications.

Final Exam: There will be a 3-hour in-class exam at the end of the semester. The final exam will be held on Friday, 12/13/24, 9:00 a.m. – 12:00 p.m. Location to be announced by Registrar.)

Seating: Select the seat you want for the semester on Tuesday, September 10. A seating chart will be prepared and you will be expected to sit in the same seat each class. Please use your name card each class all semester, even if you are confident that the instructor knows your name.

Study Groups: Participation in study groups is required. We will arrange groups. Their composition will persist throughout the semester.

Breakout Groups: Participation in breakout groups during class is required. We will arrange the groups. Their composition will change, perhaps two or three times, during the term. One goal of breakout groups is to get to know different students.

Sections: Weekly sections will be taught by our able teaching fellows. The sections are important to attend, since they cover core concepts mentioned but not developed in lectures. They will review some topics covered in class or in readings, and will provide guidance in approaching problem sets (indeed, provide hints). Some review sessions will cover supplementary material. Those discussions may focus on methodological topics, e.g., new developments in behavioral economics, or areas of application, e.g., economic development or corruption. Despite our best efforts, arranging a section time that is accessible to each and every student is not possible. We will video record our review sessions to lessen any difficulties on this score.

Office hours: The professor will have regular office hours during the semester, with sign-up through Microsoft Bookings (link available on the Canvas course site). The TFs will have extensive office hours, with their own sign-up arrangement.

Problem of the Day: For a small number of classes a Problem of the Day will be on the reading list or distributed in real time. It will be the focus for a significant amount of discussion for the next class. Students will be expected to analyze the problem of the day and be prepared to discuss their thinking and/or results. For some problems, collaboration will be permitted. The Problem of the Day is not to be turned in.

Discussion Question of the Day: For some classes, a discussion question will be on the reading list or distributed in real time. Students will usually be expected to submit a written response prior to class, electronically. These responses will be brief – words only, no math. The Discussion Question of the Day response is to be submitted online on the Canvas course site by 2:00 p.m. the day before the class in which it will be discussed. Credit is given.

Very Brief Paper Deploying Conceptual Tool(s) to Address Policy Issue: Every student will be expected to turn in a paper of 700 to 1,000 words before the last day of class. The paper should utilize some tool or tools from the course to address a policy issue. Each student will be assigned a teaching fellow as mentor on the basis of a couple of paragraphs proposal. When they are a bit further along in development, they should submit a 200-300 word proposal for feedback from the professor.

Text and Readings

Materials in this course will be available online on the Canvas course site. Short materials prepared by API-302 participants, including class notes, will also be distributed online on the Canvas course site.

There are many more readings than students are expected to do. That enables students to pursue topics in greater depth when they have an interest in either an analytic tool or policy topic. Required readings are indicated on the Canvas course site and on the Reading Lists are marked with asterisks (*).

Required textbooks: Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis*, is posted on the Canvas course site. Dan Levy, *Maxims for Thinking Analytically: The wisdom of legendary Harvard Professor Richard Zeckhauser*, is available from Amazon.

Chris Avery and Richard Zeckhauser are preparing a textbook that will accompany API-302. This book goes into much greater detail on many of the analytic techniques addressed in the course. The

material is above the level that will be discussed in class, or that is expected that most students will learn. The book is made available for students who are eager to see more rigorous presentations. The book completed thus far will be posted for student use at the beginning of the course. Additional materials from the book will be distributed as they are completed.

The following are useful references. If you wish to buy a text, there are multiple examples on both game theory and economics. Look at more than one before you leap. Most of these books are classics and may be available as cheap used copies. Only those marked with an asterisk are required.

Alpha C. Chiang, *Fundamental Methods of Mathematical Economics* (often used as a text for "Mathematics for Economists" course in Economics Department)

Thomas E. Copeland and J. Fred Weston, *Financial Theory and Corporate Policy* (a helpful, comprehensible finance text)

Morris H. DeGroot, *Probability and Statistics* (a thorough, mathematically oriented approach to probability and statistics)

Avinash Dixit and Susan Skeath, *Games of Strategy* (a highly accessible text on game theory)

Robert Gibbons, *Game Theory for Applied Economists* (a somewhat challenging but basically accessible game theory text with an emphasis on application)

Ian Hacking, *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Statistical Inference* (a central theme of API-302 is that the world is much more uncertain than we think, that even reasonably sophisticated individuals have difficulty addressing uncertainty. This brilliant book points out that probability did not begin to be understood until late in the 17th century. Our current understanding, including subjective probability, only developed in the 20th century.

Frederick S. Hillier and Gerald J. Lieberman, *Introduction to Operations Research* (a good, reasonably easy supplementary text on analytic techniques)

Daniel Kahneman, *Thinking, Fast and Slow* (a relatively recent broad-ranging book on behavioral decision)

Daniel Kahneman, Paul Slovic, and Amos Tversky, *Judgment Under Uncertainty: Heuristics and Biases* (a collection of excellent pioneering articles on behavioral decision)

David M. Kreps, *A Course in Microeconomic Theory* (an elegantly presented text, with an emphasis on game theory. You might purchase this volume if you have a strong interest in economics.)

*Dan Levy, *Maxims for Thinking Analytically: The wisdom of legendary Harvard Professor Richard Zeckhauser* (This book was published in June 2021. Professor Zeckhauser identifies various course maxims as the semester proceeds. Levy, his colleague, solicited Zeckhauser's collaborators, and some past students to provide illustrations for an array of maxims, and wove the maxims and responses into a book. The book is available inexpensively in paperback and Kindle on Amazon. This book is required reading.)

R. Duncan Luce and Howard Raiffa, *Games and Decisions* (a classic, reasonably accessible presentation of game theory)

Greg Mankiw, *Principles of Microeconomics* (a clear and accessible and highly regarded introduction to microeconomics)

Roger B. Myerson, *Game Theory* (a contemporary but advanced text)

Walter Nicholson, *Microeconomic Theory* (a good microeconomics text that is a touch more advanced than Mankiw. It covers required background material on microeconomics.)

Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics* (an excellent introductory text)

*Howard Raiffa, *Decision Analysis* (the most accessible way to learn this important material. Parts are required for the course and posted on the Canvas course site.)

Howard Raiffa, John Richardson, and David Metcalfe, *Negotiation Analysis: The Science and Art of Collaborative Decision Making* (the most recent masterful treatise by Raiffa)

*Thomas Schelling, *Micromotives and Macrobehavior* (though not a textbook, this book teaches by example. It is an elegant presentation of interactive models applied to policy. Parts are required for the course and posted on the Canvas course site.)

*Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis* (covers required background material in analytic methods at an introductory level. Parts are required for the course and posted on the Canvas course site.)

Richard Thaler, *The Winner's Curse* (highly readable and full of fun-filled facts)

Jean Tirole, *The Theory of Industrial Organization* (an excellent and challenging book on the current state of industrial organization, with an emphasis on game theory)

Hal R. Varian, *Microeconomic Analysis* (a useful, more advanced text)

Harvey M. Wagner, *Principles of Operations Research* (a supplementary text, more difficult than Hillier and Lieberman)

Course materials will be numbered in sequence as either **A** (administrative), **S** (short pieces, often newspaper articles), **R** (readings), **PS** (problem sets and solutions), **D** (discussion questions of the day), or **P** (problems of the day).

Problem Sets

Problem Set	Due Date
One	Thursday, October 3 (distributed 9/12)
Two	Tuesday, October 29 (distributed 10/8)
Three	Tuesday, November 26 (distributed 11/5)

Problem sets are due by 10:30 a.m. (EST) at the beginning of class. On occasion, an additional problem will be presented in class that can substitute for portions of a problem set. A short paper may be assigned that can substitute for some or all of Problem Set Three. Late problem sets are penalized 10 points immediately and then 10 additional points every additional 24 hours.

Our problem sets are notorious for the challenge presented by some problems, and the time they require. There is substantial benefit from working on problem sets in person with other members of one's problem set group, and in getting direct guidance from the TFs.

We organize students into study groups, primarily to work on problem sets. Even if you can do the problem set without the help of a group, you will get more out of the problem set by working with others. There is much to be learned from seeing others' approaches to modeling and problem-solving. There is also much to be learned from teaching.

Collaboration on problem sets **must not** include the preparation of final answers: all students must write up their answers independently. This means that problem set collaboration is limited to discussion only, perhaps with the help of a white board or scrap paper. No text, Excel formula, or equation should be copied verbatim in the process, and no student should share his or her write-ups with others. In fact, students should not even sit together and write up answers in close collaboration. While students may share a common approach and even final numeric solutions, all write-ups must be independent.

Students who consult a previous year's answer keys, copy another's work, or give their work to be copied will be deemed to have cheated and will be punished appropriately. Please, please, do not cheat. We prosecute. That said, be open and generous in your discussions; helping others is a good thing in API-302, as in life.

Math Review

In the first two or three weeks of class, we will conduct math review sessions each Friday, beginning on September 13. These sessions are mandatory for anyone who is not comfortable with the material that will be covered. Although this is not a course on mathematics or quantitative methods, you will better understand and formulate many of the intuitive ideas presented in the class with the help of some basic mathematical techniques. In addition, the material covered in these math reviews will be useful groundwork for the problem sets and the final exam. (It should also be useful for other courses, and for life.) Note, however, that our assumption is that you have little or a moderate amount of training in mathematics but are willing to learn as required. There will also be an Excel simulation review (date/time to be announced).

A book on quantitative techniques for API-302, more advanced than Stokey and Zeckhauser, is being prepared by Chris Avery and Zeckhauser, and is described further below. It temporarily has the highly creative title of Analytic Frameworks for Policy. If and when portions become available, they will be posted on the Canvas course site.

Math Review 1, 2, and 3

Algebra and Math Tools: logarithms and exponents, series and sums of infinite series, difference equations, etc. (read Part I of R-A, "Notes on Math Basics")

Probability: sample spaces and events, conditional probabilities, Bayes rules, random variables, probability distribution and density functions (binomial, uniform, normal, etc.) (read R-B, "Notes on Probability")

Calculus: functions and derivatives, differential rules, optimization techniques, introductory integral calculus (read Part II of R-A, "Notes on Math Basics")

Matrices: Matrix addition, multiplication, inversion

Spreadsheets: simulation, Markov processes, random variables, matrices

Videos by Chris Avery on Math Topics

Professor Avery has made brief (roughly 15-minute) videos on a handful of math-related topics that arise in the course. The subjects are: Well Behaved Problems and Profit Maximization; Dynamic Programming and the Motor-Rotor Problem; S-Shaped Optimization; Shadow Prices and Constraints; Good News and Bad News: Updating Probabilities with New Information. These are not required, but some students will find them useful. They can be found on the Canvas course site.

Discussion Board

API-302 will be employing a discussion board, available on our Canvas course site. Students will be encouraged to engage in online discussion as an adjunct to class participation.

Traditionally, teaching fellows and course assistants get inundated with requests for help shortly before problem sets are due. Teaching fellows and course assistants will have a blackout period of 72 hours before a problem set. For that period, all student inquiries relating to the problem set will be taken only via the discussion board. That process shares information widely, and also assures that any response that could include hints on how to proceed will be available to the whole class. We reserve

the right to alter this format during the semester, as we learn about its strengths and weaknesses. We will also maintain a chat room after graduation for API-302 graduates.

Administrative questions, e.g., about whether an assignment was received, should be submitted to a TF at any time.

ChatGPT and Artificial Intelligence

We will discuss artificial intelligence at some junctures in the class. There will also be guest lectures on this subject by professors who are knowledgeable in this field. The professor, who is a neophyte in this field, encourages students to learn to utilize AI capabilities. As AI develops, it is essential that humans learn to develop complementary skills alongside.

Students are welcome to use AI in mastering material. However, they cannot hand in materials derived from AI as part of any assignment.

If, as is common, the professor asks for examples illustrating a particular point or utilizing a particular tool, it is fine to use AI to help. However, when providing an example you should say "AI assisted."

Previous Work

Designing this course is a challenge, given the varying backgrounds of our students. A number of MPP and two-year MPA students took analytics and economics courses last year. Enrollees from the Mid-Career Program are likely to have taken the advanced Analytics Section in the Summer Program. A few of you will be taking the course, "Microeconomic Theory" (API-111) concurrently. These courses contain some of the material that has been taught in API-302 in the past.

But we are nothing if not flexible. We have tried to develop a curriculum that avoids overlap with prior efforts to the extent possible, yet covers relevant materials so individuals without this prior work will not suffer. As we shall discuss during the course, it is impossible to maximize simultaneously on two dimensions. But we can strive to strike an appropriate balance, and we shall so strive.

First, where some old material is only important, but not essential, we may replace it with some other important topic. Second, for the essential material, we shall ask those who have little background in analytic methods to do a modest amount of background reading in *A Primer for Policy Analysis*. Third, if one or two holes are discovered as we proceed, our course assistants will hold special review sessions.

Ph.D. Students

API-302 is designed to help push Ph.D. students on their way to undertaking research. Unlike most analytic Ph.D. courses, however, it does not emphasize imparting specific techniques. Indeed, some Ph.D. students will feel they know the math-related tools already. Rather, the goal for Ph.D. students, and indeed all students, is to give them experience with applying tools to real issues, to thinking creatively beyond the presentation of the teacher, and to creating their own tools. Early in the semester our TFs, who are all active researchers, will conduct a session discussing how Ph.D. and prospective Ph.D. students can get the most out of the course. An effective Ph.D. student should use the course to develop at least one solid idea for a research paper during the term.

Accessibility & Accommodations for Student Learning

Harvard University values inclusive excellence and providing equal educational opportunities for all students. Our goal is to remove barriers for disabled students related to inaccessible elements of instruction or design in this course. If reasonable accommodations are necessary to provide access, please contact the local disability coordinator, Melissa Wojciechowski St. John

(melissa_wojciechowski@hks.harvard.edu). She is the Senior Director of Student Services in the HKS Office of Student Services. Accommodations do not alter fundamental requirements of the course and are not retroactive. Students should request accommodations as early as possible, since they may take time to implement. Students should notify Melissa at any time during the semester if adjustments to their communicated accommodation plan are needed.

OUTLINE OF CLASSES

I. **Introduction** – September 5, 2024

II. **Conceptual Thinking, Modeling, and Optimization** (6 Sessions)

September 10 Conceptual Thinking and Modeling
September 12 Simulation and Markov Chains
September 17 Heterogeneity – will also be discussed in Introduction class
September 19 Lagrange Multipliers and Resource Economics
September 24 Dynamic Optimization and Policy Decisions and High Shadow Price Activities that Were Slighted
September 26 Catch Up Day for Conceptual Thinking, Modeling, and Optimization

III. **Uncertainty, Information, and Risk Sharing** (6 sessions)
October 1 through October 17

IV. **Behavioral versus Rational Economics** (5 sessions)
October 22 through November 5

V. **Game Theory, Commitment, Interactive Decision, Social Choice** (6 sessions)
November 7 through November 26

VI. **Organizing Society and Applications; Summing Up** (2 sessions)
December 3 through December 5

Section VI is for those of you who are eager to think a bit more, perhaps a bit more broadly, about the material in our course. It has the potential to launch a lifetime habit of reading pieces that unite analytic methods and policy concerns. Such a habit would stimulate your mind and also enable you to think more clearly about the world. – **It is likely that we will not get to Section VI in class. If we do not, you are not responsible for any of the material in that section.**

VII. **Reading Period Assignment** (to be announced)

VIII. **Examination**
Friday, 12/13/24, 9:00 a.m. – 12:00 p.m. Location to be announced by Registrar.
3-hour in-class written Exam.

OPENING NOTE

We are sensitive to COVID-19 concerns, which as of September 2024 are under control. However, our approach may evolve over the semester. Nevertheless, we will have four types of breakouts as a regular part of our sessions:

1. Micro-breakouts. Polls to be answered by students individually. – These are usually questions about the analytics of the material just covered or about to be covered. Thus, a micro-breakout question might ask: "Given the assumptions made, is it clear whether the shadow price on the budget total would increase?" Answers will be provided by Poll Everywhere.

2. Breakouts. Questions to be answered by students in small groups. These are somewhat broader and less technical questions. Often they will be looking for an example of a concept just discussed. Thus, a breakout question might ask: "Please provide an example of an instrument that could be used to target a social program more effectively to deserving individuals." A breakout might be 2 or 3 minutes. We might ask students to type their answers in one or two sentences.

3. Macro-breakouts. These are questions that require some prior thought. They will be posted on Canvas at least a day before they are supposed to be discussed. They will be given to students in breakout groups, with somewhere between 5 and 15 minutes. Below is an example of a past breakout question:

   "Beirut Explosions

   On August 4, 2020, two massive explosions at ammonium nitrate storage sites in Beirut harbor caused massive losses. More than 200 people died, more than 7,000 were injured, and the property losses were in the many billions. It had been known for years that it was extremely dangerous to store this material in the middle of a major city. Yet the government did nothing.

   It was clear that the government would fall because of this disaster. We can be confident of one fact. The government would have liked to have stayed in power. That is perhaps doubly true, because it had been widely observed that the government was quite corrupt.

   This leads to a puzzling observation. The leaders of the government will suffer substantially. (In the longer run, some might even go to jail.) Why didn't these leaders deal with this problem?

   After you answer this question, identify other problems with some of these characteristics where governments "sleep" while problems fester. What types of problems are most vulnerable to this phenomenon?"

4. Discussion Questions of the Day. On a fairly regular basis in the course, we will give students a discussion question that they are supposed to hand in before the next class. The professor will call on one or a few students to present their answers.

Composition of Groups for Breakouts and Macro-Breakouts

One of the best elements of API-302 classes in the past was that students got to work with individuals from different backgrounds. Thus, we intend to assign students to different groups when we have Breakout or Macro-breakout groups, hoping to facilitate such interactions.

Composition of Groups for Problem Sets

Historically, we have also assigned students to problem set groups. These groups persist throughout the semester. We hope that such groups help to forge longer-term relationships. They often have done so in the past.

Book on Formal Techniques Prepared for API-302; Pre-Class Lectures on Analytic Material; *A Primer for Policy Analysis*

API-302 is fortunate that Professor Christopher Avery has pushed hard on creating materials on the formal techniques that are used in the course. Richard Zeckhauser has been rewriting, adding examples and what might be called adding color commentary to the volume. Dan Levy has been an active cheerleader on this team. This material is more advanced than what we expect in the course, though some students will welcome it. Material from this book will be posted on the Canvas course site, as mentioned, if and when it becomes available.

Professor Avery has prepared and is still preparing a number of mini-lectures on technical material, such as on critical ratios, risk aversion, and prior and posterior distributions. These mini-lectures – perhaps ten in number – are about 15 minutes in length. Students will find it beneficial to "attend" these lectures before classes.

Less technically oriented students might use the book by Edith Stokey and Richard Zeckhauser, *A Primer for Policy Analysis*.

READING LIST I

Please note. Only readings with an asterisk (*) are required reading.

This reading list is as of August 27, 2024. There will be some minor adjustments before the course begins.

September 5 – Introduction

September 10 – Conceptual Thinking and Modeling

R-A *Ko, "Notes on Math Basics" (Read prior to first Math Review Session)

R-1 *Adams, "Introduction," and "Perceptual Blocks," Chapters 1 and 2, in *Conceptual Blockbusting*, pp. 1-11, 13-36.

R-2 Feynman, "The Relation of Mathematics to Physics," Chapter 2, in *The Character of Physical Law*, pp. 35-58.

R-3 *Schelling, "Micromotives and Macrobehavior," and "The Inescapable Mathematics of Musical Chairs," Chapters 1 and 2, in *Micromotives and Macrobehavior*.

R-4 Gribbin, *Richard Feynman: A Life in Science*, excerpts.

Short Articles
S-1 Zeckhauser, "Statistics and Modeling"
S-2 Angier, "Mating for Life? It's Not for the Birds or the Bees"
S-3 Angier, "Radical New View of the Role of Menstruation"
S-4 AP, "Emergency Room Gridlock"
S-5 Ravo, "As Deer Increase, Their Charm Fades"
S-6 Sterba, "Even a Real Genius Notes that Bambi is a Relevant Factor"
S-7 Schmidt, "Clash of Deer and Man Tests Public Ingenuity"
S-8 Foreman, "Ultrasound Benefit in Pregnancy Disputed"
S-9 Staff of *The Economist*, "The Puzzling Failure of Economics"
S-10 Staff of *The Economist*, "Play it Again, Samuelson"
*S-10.1 Staff of *The Economist*, "Economics Sometimes Changes its Mind"

P-1 Problem of the Day: COVID-19, Booster Shots, India's Delta Experience. Posted on Canvas course site. Not to be turned in.

September 12 – Simulation and Markov Chains

A central theme of our course is that the world is highly uncertain, and also much more uncertain than most people think. Witness the ravages of COVID-19, the rapid collapse of Afghanistan, the extraordinary response to the murder of George Floyd. Think of Russia's invasion of Ukraine, Russia's failure to achieve a swift victory, and the August 2024 invasion of Russia by Ukraine. Consider rapid inflation across the world.

When there are substantial uncertainties, the number of possibilities often explodes. In such circumstances, it is often desirable to use simulation to create a description of outcomes. That description will usually be a probability distribution across outcomes.

R-B Pollack, "Notes on Probability" (Read prior to second Math Review Session.) This is an alternative to some material in the Avery book. IMPORTANT NOTE. Christopher Avery and Richard Zeckhauser are working on a much more extensive volume on analytic techniques employed in the course. Portions

of it may become available during the course. This volume may appeal to individuals who wish to delve further into the mathematics underlying some of our discussions. None of its material will be required.

R-5 *"Markov Chains : Motivational Introduction"

R-6 *Stokey and Zeckhauser, "Markov Models," Chapter 7, in *A Primer for Policy Analysis*, pp. 98-114.

R-7 "Markov Chains"

R-8 *Stokey and Zeckhauser, "Simulation," Chapter 6, in *A Primer for Policy Analysis*, pp. 89-97.

R-9 Hendricks, "Notes on Computer Simulations"

R-10 *"Marsh and McLennan" (A)

Short Articles

S-11 Culotta, "Forecasting the Global AIDS Epidemic"
S-12 Rees and Smith, "The End of Mandatory Retirement for Tenured Faculty"
S-13 Wofsey, "Technology"
S-14 Greer, "HMO Rates for Women Are Challenged"
S-15 Altman, "New Method of Analyzing Health Data Stirs Debate"
S-15.1 *Mandavalli, "This Trawler's Haul: Evidence That Antibodies Block the Coronavirus"

D-1 Discussion Question of the Day: In the first class, we discussed briefly situations where severe policy disagreements result because individuals hold dramatically different models of the world. For this class, by Wednesday, September 11, at 2:00 p.m., submit one paragraph (online via Canvas course site) on a situation you have witnessed where policy disagreement related to individuals holding different models. (See Patt, "Economists and Ecologists: Modelling Global Climate Change to Different Conclusions," [posted Canvas course site], as a much more extended example.)

P-2 Problem of the Day: Steam Detector Problem (3-person collaboration permitted). Posted on Canvas course site. The problem will be briefly discussed in class. Not to be turned in. In a subsequent class, some volunteers will be asked to make a presentation on this problem.

Note: The uncertainties discussed under simulation and Markov chains are those where, what we might label, micro probabilities are established or assumed. That assumption is reasonable for the spread of an epidemic. It is not for phenomena such as the Russian invasion of the Ukraine.

Problem Set 1 to be distributed 9/12/24.

September 17 – Heterogeneity – RECURRING THEME IN COURSE, ALREADY DISCUSSED IN RELATION TO COVID-19

R-11 "Marsh and McLennan" (B) (will be posted on the Canvas course site later)

R-12 *Pollack, "Notes on Heterogeneity and Measurement"

R-13 Bane and Ellwood, "Slipping Into and Out of Poverty: The Dynamics of Spells," *Journal of Human Resources*, vol. 21, no. 1, Winter 1986, pp. 1-23.

R-14 Zeckhauser, Sato, and Rizzo, "Hidden Heterogeneity in Risk: Evidence from Japanese Mortality," *Health Intervention and Population Heterogeneity*, December 1985, pp. 23-48.

R-14.1 Athey, Ferguson, Gentzkow, and Schmidt, "Experienced Segregation," Stanford Institute for Economic Policy Research Working Paper No. 20-034 and NBER Working Paper No. 27572, July 2020, pp. 1-54. This article demonstrates our ability to utilize contemporary technological tools to assess important policy phenomena, such as the degree of segregation in society. For example, this article makes

clear that black individuals living within the same highly segregated neighborhood experience very different levels of "lived segregation."

R-14.2 DiCorato, "Repeat Offenders Analysis shows how a rare population of cancer cells contributes to disease relapse." This article discusses previously unknown heterogeneity among cancer cells. Unfortunately, a small minority of cells can be responsible for delayed recurrences.

Short Article

S-15.2 *Weiland, LaFraniere, and Fink, "F.D.A.'s Emergency Approval of Blood Plasma Is Now on Hold"

B-A Breakout problem.

September 19 – Lagrange Multipliers and Resource Economics – SHADOW PRICES, RECURRING THEME IN COURSE

Today will also offer our first introduction to the concept of *critical ratios*. That concept will reappear multiple times in the course. Thus, beyond maximization applications, it can guide decision making on hypothesis testing in statistics, and fair division in game theory. Learning to think in terms of ratios is a skill that will help you across a broad array of circumstances.

R-15 *"Programmed Exercises on Lagrange Multipliers"

R-16 Baumol, "Constrained Maxima: Lagrange Multipliers," Chapter 4, Section 8, in *Economic Theory and Operations Analysis*, pp. 62-67.

R-17 *Pollack and Zeckhauser, "Budgets as Dynamic Gatekeepers," *Management Science*, vol. 42, no. 5, May 1996, pp. 642-658. Anyone who has been employed in a responsible position has experienced the situation of juggling a budget to utilize the available resources fully by the end of the budget period. Obviously, as this article shows, such juggling leads to some far-from-optimal behavior. Please think about why organizations, governmental, for-profit and not-for-profit still use budgets as a prime management tool.

R-18 *Solow, "The Economics of Resources or the Resources of Economics," *American Economic Review*, vol. 64, no. 2, May 1974, pp. 1-14.

R-18.1 Weitzman, "Prices vs. Quantities," *Review of Economic Studies,* vol. 41, no. 4, 1974, pp. 477-491. This is a highly influential article. It anticipated the debate on whether carbon dioxide emissions should be controlled through a cap-and-trade system, or through carbon prices. The article is difficult, but you might peruse it to get its flavor. We will review the price-versus-quantity debate in the context of affirmative action in our Problem of the Day discussion on affirmative action.

R-18.2 *Aldy and Zeckhauser, "Three Prongs for Prudent Climate Policy," *Southern Economic Journal*, vol. 87, no. 1, 2020, pp. 3-29. This article argues that society should use three instruments to control climate change: mitigation, adaptation, and amelioration. It reaches that conclusion after recognizing that mitigation, e.g., reducing the emissions of greenhouse gases, alone will not prevent severe damages from climate change.

Interestingly, the tools of adaptation have received only modest attention. Research on amelioration (e.g., geoengineering) has been opposed by many in the environmental community and is proceeding on a very small scale.

In class, we will use this article to discuss efficient production when there are three factors of production. Please think about the way to set this situation up as a problem in constrained maximization. (You need not agree with the article to engage in this exercise.)

R-18.3 Cook, Logan, and Parman, "The Mortality Consequences of Distinctively Black Names," *Explorations in Economics History*, vol. 59, no. 1, 2016, pp. 114-125. This article finds that from 1802-1970, blacks with distinctively black names lived longer than blacks without such names. That finding is intriguing, but thus far unexplained. We will discuss the critical ratios feature utilized in identifying such names.

Short Articles

S-16 Kosterlitz, "Rationing Health Care"
S-17 Egan, "Oregon Lists Illnesses by Priority to See Who Gets Medicaid Care"
S-18 AP, "Oregon's Brave Medical Experiment"

D-2 Discussion Question of the Day: Counting the Children in Katmandu. Posted on Canvas course site. Due by Wednesday, September 18, at 2:00 p.m.

Enrichment Problem: Oregon Experiment. Completing this problem is not required. Find it on the Canvas course site.

September 24 - Dynamic Optimization and Policy Decisions and High Shadow Price Activities that Were Slighted

R-19 Blumenthal and Zeckhauser, "The Artificial Heart as an Economic Issue," in *After Barney Clark*, pp. 149-167. (Make sure you understand the dynamic planning features in this article. Can you relate this in any way to the current debate over the use of stem cell technology? Some critics would like to slow artificial intelligence work for concerns like those that arose with the artificial heart.)

R-19.1 *Sands, El Turabi, Saynisch, and Dzau, "Assessment of Economic Vulnerability to Infectious Disease Crises," *The Lancet*, vol. 388, 2016, pp. 2443-2448. This piece, with three authors who are graduates of API-302, looks extremely prescient. We all wish that they had been off base. (Peter Sands, formerly the head of a major bank, now heads the Global Fund, which spends $4 billion/year fighting disease in developing nations.)

R-20 *Read, "Deterministic Reservoir Operation: An Application of the Economic Principles," New Zealand Ministry of Energy Report # ER4006.

R-21 *Epple and Lave, "Helium Policies," *Science*, vol. 225, 1984, pp. 784-785.

R-22 Patt, "Separating Analysis from Politics: Acid Rain in Europe," *Policy Studies Review*, vol.16, no. 3/4, 1999, pp. 104-137.

R-23 Trefil, "Modeling Earth's Future Climate Requires Both Science and Guesswork," *Smithsonian*, vol. 21, no. 9, December 1990, pp. 29-37.

R-24 *Keohane, Van Roy, and Zeckhauser, "Managing the Quality of a Resource with Stock and Flow Controls," *Journal of Public Economics*, vol. 91, no. 3-4, April 2007, pp. 541-569. (Read this to grasp essential elements, but do not attempt to wade through the math. Note the application of a model developed for the environment to other policy areas.)

P-3 Problem of the Day: Japanese Inventory Policy. Posted on Canvas course site. Not to be turned in.

September 26 - Catch Up Day for Conceptual Thinking, Modeling, and Optimization

R-25 Reilly et al., "Robbing Banks: Crime Does Pay – But Not Very Much," *Significance*, June 2012, pp. 17-21. We doubt that many of you are considering the profession evaluated in this article. We will use this article for another purpose: to see how to assess the returns from an activity. Be prepared to discuss the strengths and weaknesses of this analysis.

D-3 Discussion Question of the Day: Bathroom Problem. Posted on Canvas course site. Due by Wednesday, September 25, at 2:00 p.m. (This looks like a very mundane problem. Nevertheless, it is one that affects every member of this class. Moreover, it illustrates many central issues in policy analysis. Often the best way to grasp some concept intuitively is by dealing with an everyday version, implying that we already have some intuitive feel for how it works.) Note, there has been a significant change in constructing new bathrooms in recent years. In many contexts we see unisex bathrooms. We will discuss this phenomenon, including the usual design of such bathrooms. **PROCEEDING FROM THE EVERYDAY TO THE PROFOUND IS A RECURRING THEME IN THE COURSE.**

R = Reading S = Short piece (often newspaper article) D = Discussion Question of the Day P = Problem of the Day

Course materials are available online on the Canvas course site.

Reading Lists II and III to follow.

API-302
ANALYTIC FRAMEWORKS FOR POLICY
Fall 2024

Master List of Readings - Part I

All readings listed below with asterisks (*) are officially required. Our choice of required readings reflects optimization subject to constraints on your time and attention. They tend to be introductions to central subjects, or pieces that are very short. Be aware that you can read and should read articles that you do not understand fully, and optional articles that you just find interesting.

Section I. Introduction

Section II. Conceptual Thinking, Modeling, and Optimization

R-A *Ki-Seok Ko, "Notes on Math Basics." (manuscript)

R-B Harold Pollack, "Notes on Probability." (manuscript)

R-1 *James Adams, "Introduction," Chapter 1, and "Perceptual Blocks," Chapter 2, in *Conceptual Blockbusting: A Guide to Better Ideas*, Reading, MA: Addison-Wesley, 1986, pp. 1-11, 13-37.

R-2 Richard Feynman, "The Relation of Mathematics to Physics," Chapter 2, in *The Character of Physical Law*, Cambridge, MA: MIT Press, 1967, pp. 35-58.

R-3 *Thomas C. Schelling, "Micromotives and Macrobehavior," Chapter 1, and "The Inescapable Mathematics of Musical Chairs," Chapter 2, in *Micromotives and Macrobehavior*, New York: W.W. Norton & Co., 1978, pp. 11-43, 47-80.

R-4 John Gribbin and Mary Gribbin, *Richard Feynman: A Life in Science*, New York: Dutton, 1997, excerpts on pp. 76-77, 88-89, 178-179, 196-197, 216-217.

R-5 *"Markov Chains: Motivational Introduction." (manuscript)

R-6 *Edith Stokey and Richard Zeckhauser, "Markov Models," Chapter 7, in *A Primer for Policy Analysis*, New York: W.W. Norton & Co., 1978, pp. 98-114.

R-7 "Markov Chains." (manuscript)

R-8 *Edith Stokey and Richard Zeckhauser, "Simulation," Chapter 6, in *A Primer for Policy Analysis*, New York: W.W. Norton & Co., 1978, pp. 89-97.

R-9 Darryll Hendricks, "Notes on Computer Simulations." (manuscript)

R-10 *"Marsh and McLennan" (A). (Harvard Business School Case #9-171-303)

R-11 "Marsh and McLennan" (B). (Harvard Business School Case #9-175-290)

R-12 *Harold Pollack, "Notes on Heterogeneity and Measurement." (manuscript)

R-13 Mary Jo Bane and David T. Ellwood, "Slipping Into and Out of Poverty: The Dynamics of Spells," *Journal of Human Resources*, vol. 21, no. 1, Winter 1986, pp. 1-23.

R-14 Richard J. Zeckhauser, Ryuzo Sato, and John Rizzo, "Hidden Heterogeneity in Risk: Evidence from Japanese Mortality," in *Health Intervention and Population Heterogeneity: Evidence from Japan and the United States*, National Institute for Research Advancement, December 1985, pp. 23-48.

R-14.1 Susan Athey, Billy A. Ferguson, Matthew Gentzkow, and Tobias Schmidt, "Experienced Segregation," Stanford Institute for Economic Policy Research Working Paper No. 20-034 and NBER Working Paper No. 27572, July 2020, pp. 1-54.

R-14.2 Allessandra DiCorato, "Repeat Offenders Analysis shows how a rare population of cancer cells contributes to disease relapse," *Harvard Medical School, News and Research*, August 11, 2021.

R-15 *"Programmed Exercises on Lagrange Multipliers and Shadow Prices." (manuscript)

R-16 William Baumol, "Constrained Maxima: Lagrange Multipliers," Chapter 4, Section 8, in *Economic Theory and Operations Analysis*, Englewood Cliffs, NJ: Prentice-Hall, 1977, pp. 62-67.

R-17 *Harold Pollack and Richard Zeckhauser, "Budgets as Dynamic Gatekeepers," *Management Science*, vol. 42, no. 5, May 1996, pp. 642-658.

R-18 *Robert M. Solow, "The Economics of Resources or the Resources of Economics," *American Economic Review*, vol. 64, no. 2, May 1974, pp. 1-14.

R-18.1 Martin L. Weitzman, "Prices vs. Quantities," *Review of Economic Studies,* vol. 41, no. 4, 1974, pp. 477-491.

R-18.2 *Joseph E. Aldy and Richard Zeckhauser, "Three Prongs for Prudent Climate Policy," *Southern Economic Journal*, vol. 87, no. 1, 2020, pp. 3-29.

R-18.3 Lisa D. Cook, Trevon D. Logan, John M. Parman, "The Mortality Consequences of Distinctively Black Names," *Explorations in Economics History*, vol. 59, 2016, pp. 114-125.

R-19 David Blumenthal and Richard J. Zeckhauser, "The Artificial Heart as an Economic Issue," in *After Barney Clark: Reflections on the Utah Artificial Heart Program*, Margery W. Shaw, ed., Austin: University of Texas Press, 1984, pp. 149-167.

R-19.1 *Sands, El Turabi, Saynisch, and Dzau, "Assessment of Economic Vulnerability to Infectious Disease Crises," *The Lancet*, vol. 388, 2016, pp. 2443-2448.

R-20 *E. Grant Read, "Deterministic Reservoir Operation: An Application of the Economic Principles," New Zealand Ministry of Energy Report # ER4006, 1979.

R-21 *Dennis Epple and Lester Lave, "Helium Policies," letters, *Science*, vol. 225, 1984, pp. 784-785.

R-22 Anthony Patt, "Separating Analysis from Politics: Acid Rain in Europe," *Policy Studies Review*, vol.16, no. 3/4, 1999, pp. 104-137.

R-23 James Trefil, "Modeling Earth's Future Climate Requires both Science and Guesswork," *Smithsonian*, December 1990, vol. 21, no. 9, pp. 29-37.

R-24 *Nathaniel Keohane, Benjamin Van Roy, and Richard Zeckhauser, "Managing the Quality of a Resource with Stock and Flow Controls," *Journal of Public Economics*, vol. 91, no. 3-4, April 2007, pp. 541-569.

R-25 Barry Reilly, Neil Rickman, and Robert Witt, "Robbing Banks: Crime Does Pay – But Not Very Much," *Significance*, June 2012, pp. 17-21.

The following Reading List sections will be handed out at a later date: Section III. Uncertainty, Information, and Risk Sharing; Section IV. Behavioral versus Rational Economics; Section V. Game Theory, Commitment, Interactive Decision, Social Choice; and Section VI. Organizing Society and Applications