

My Teaching Dossier includes:

- Teaching statement;
- Teaching evaluations;
- Sample syllabi (Consumer behavior and Behavioral economics);
- Sample course material (from my Teaching Assistant recitations).

I am comfortable teaching at the undergraduate, graduate, and MBA level. I have direct experience teaching behavioral and experimental economics, market design, and microeconomics. I can teach core economics courses, industrial organization, information economics, game theory, consumer behavior, marketing, and related disciplines.

My teaching experience includes:

- Teaching assistant for behavioral economics, market design, and microeconomics courses;
- Lab manager for the experimental economics laboratory, supervising research activities, training new experimenters, and teaching workshops on experimental techniques;
- Mentor for the Laidlaw summer program (Columbia University), guiding a group of students with diverse backgrounds in their independent research projects;
- Organizer of the Columbia Experimental Lunch (faculty and graduate students) and of the Student Workshop in Experimental Economics Techniques (graduate students from Columbia University, NYU, Princeton, and Wharton);
- I worked with undergraduate research assistants for applied microeconomics and experimental economics research projects;
- I regularly presented my research in colloquia (Columbia University), workshops, and conferences (talks and posters).

[†] Department of Economics, Columbia University; e-mail: sr3300@columbia.edu; website: silvioravaioli.com.

As an Economics teaching assistant and mentor, I had the duty and honor to guide students building formal mathematical tools, and applying them to understand the world and make a difference.

I am grateful I had the chance to serve as teaching assistant for various courses as part of my Ph.D. requirements at Columbia University, and previously as a Master student at University of Pisa. My direct experience, the conversations with instructors and colleagues, and especially the interactions with my students crafted my core values and goals as teacher.

Effective communication. Economics analyzes behavior through mathematical models, and I find it important to combine intuition, implications, and applications of the models. I often rely on real-life examples to illustrate the usefulness of the more abstract concepts. For instance, when teaching market design, given the diverse background of my students (many were not taking economics as a major), I used examples that were close to their experience, including dorm rooms assignment and eBay auctions.

Engagement with research. Research and teaching are two important and connected aspects of my academic journey. I believe that it is fundamental that students have the chance to engage with questions and methods on the research frontier. It is my priority to show how research is the compass that discovers uncharted territories of knowledge, by exploring new questions, methodologies, and data. I found three interesting ways of doing so, and these strategies can be pursued at any level of teaching. First, include in the syllabus an overview of a specific topics on the research frontier. Second, create problem set exercises based on a simpler version of models from recent papers. Third, encourage creativity by having students face open questions in problem sets, requiring them to use the acquired knowledge to propose solutions to new problems.

Inclusive and welcoming environment. In order to teach effectively, the classroom needs to be an inclusive and welcoming environment. I use gender-neutral pronouns and gender- and ethnic-neutral names in examples and exercises to avoid students feeling excluded or discriminated against. I believe the best way to generate positive dynamics in the classroom is by encouraging interaction between students. I intend to have an open-door policy to make myself available to students and pay special attention to students showing signs of struggling with the materials.

Continuous assessment. I support continuous assessment grading policies, by decreasing the weight that term exams have on the final grade with respect to problem sets and other activities such as participation, research essay, or presentations. I want to reduce stress peaks and promote continuous learning and assimilation of the courses' materials.

Concluding remarks. I believe that my teaching improved substantially as a teaching assistant at Columbia University, and I look forward to continuing growing my skills and learning from my future colleagues. My teaching skills improved my research, by nudging me to create connections between topics and simply complex concepts. And my research skills improved my teaching, by adopting a formal approach to define the problems and the tools available to solve them. I want my passion for research and teaching to continue complementing each other. And I want to leave an imprint on my students' ability to understand better the world through the eyes of an economist.

[†] Department of Economics, Columbia University; e-mail: sr3300@columbia.edu; website: silvioravaioli.com.

I received teaching evaluations for the following courses (details on the next pages):

- Behavioral Economics.
 - Fall 2018: overall assessment 4.84/5.
 - Fall 2017: overall assessment 4.67/5.
- Market Design.
 - Spring 2019: overall assessment 4.29/5.
 - Spring 2018: overall assessment 4.18/5.

This is a selection of anonymous comments written by my students.

- Silvio was GREAT. Reliable, always there to help, a nice person in general. And he seems to know the subject as good as the Professor, but has a more engaging lecturing style. I wouldn't mind him teaching the same class.
- In my opinion, Silvio is a great TA. He is very enthusiastic about the material and also does a great job at explaining the especially pertinent parts that we learned during lecture in his recitation. The two labs that he led were facilitated very well and he was effective at explaining how we were to proceed with each experiment. Silvio was also willing to devote his time to ensure that the students were able to understand the material. It would have been easy to leave us out in the cold with a very difficult course-load but Silvio did the opposite by making sure that we were capable of learning it.
- Silvio may be the best TA I have ever had. He clearly spends a lot of time preparing, and his recitations are always very well-organized. He also held very helpful review sessions for the midterm and final. Whenever I had missed something in lecture, Silvio's recitations made it very clear what the key ideas were and how to apply them. He is a very engaging and enthusiastic lecturer, and he is clearly passionate both about the material from this class and about teaching.
- Silvio is a very smart TA who has perfect teaching skills. I couldn't ask for a better TA than Silvio since he always switched he way of explaining things if I didn't understand.
- Silvio is the best TA I have ever had. He truly cares if students understand the material. He goes above and beyond to prepare for office hours and recitation sections. It is incredible to see Silvio's passion and excitement for this course material—it makes his students excited to learn. Silvio's ability as a TA has impressed me. He has a clear natural talent for both economics and instruction.

I do not have teaching evaluations for my other activities (microeconomics at University of Pisa, workshops on experimental economics methods, mentor for the Laidlaw program). I am happy to share sample material or additional details about these activities.

[†] Department of Economics, Columbia University; e-mail: sr3300@columbia.edu; website: silvioravaioli.com.

Columbia University: Arts & Sciences
A&S Fall 2018 Standard Evaluation

Course: ECONGU4850_001_2018_3-COGNITIVEMECH&ECONBEHAVIOR: ECONGU4850_001_2018_3 - COGNITIVE MECH & ECON BEHAVIOR

Instructor: Michael Woodford

TA: Silvio Ravaoli *



Response Rate: 19/28 (67.86 %)

1 - What are the strengths and weaknesses of Silvio Ravaoli (discussion section leader, lab section leader, grader) as an instructor, and how might Silvio Ravaoli's teaching be improved?

Response Rate

7/28 (25%)

- Fantastic. Extremely helpful. Gave me a great deal of suggestions. Recitations would be perfect if mathematical and statistical derivations of the models introduced in the lecture could be included.
- Silvio was GREAT. Reliable, always there to help, a nice person in general. And he seems to know the subject as good as the Professor, but has a more engaging lecturing style. I wouldn't mind him teaching the same class.
- Very helpful and seemed to genuinely care about his students' learning. Quick to respond to emails/Piazza posts.
- Silvio was an excellent TA. He was very knowledgeable, helpful, and kind.
- Silvio has been excellent. He provides timely responses to any and all questions on Piazza, and is always ready to offer help on the problem sets or to clarify our doubts during his recitations, office hours or after lectures. He also carried out the lab experiments effectively. As an grader, he grades very fairly and carefully, and is always ready to explain where you have gone wrong in your response.
- In my opinion, Silvio is a great TA. He is very enthusiastic about the material and also does a great job at explaining the especially pertinent parts that we learned during lecture in his recitation. The two labs that he led were facilitated very well and he was effective at explaining how we were to proceed with each experiment. Silvio was also willing to devote his time to ensure that the students were able to understand the material. It would have been easy to leave us out in the cold with a very difficult course-load but Silvio did the opposite by making sure that we were capable of learning it.
- Silvio may be the best TA I have ever had. He clearly spends a lot of time preparing, and his recitations are always very well-organized. He also held very helpful review sessions for the midterm and final. Whenever I had missed something in lecture, Silvio's recitations made it very clear what the key ideas were and how to apply them. He is a very engaging and enthusiastic lecturer, and he is clearly passionate both about the material from this class and about teaching.

2 - What is your overall assessment of the effectiveness of Silvio Ravaoli?							
Response Option	Weight	Frequency	Percent	Percent Responses	Means		
Excellent	(5)	17	89.47%			4.84	
Very Good	(4)	1	5.26%				
Good	(3)	1	5.26%				
Fair	(2)	0	0.00%				
Poor	(1)	0	0.00%				
				02550100	Question		
Response Rate				Mean	STD		Median
19/28 (67.86%)				4.84	0.50		5.00

Title: **A&S Fall 2017 Standard Evaluation**

Dates: **12/04/2017 - 12/14/2017**

Course: **ECONW4850_001_2017_3 / Cognitive Mechanisms and Econ**

Responses: **8/14 - 57.14%**

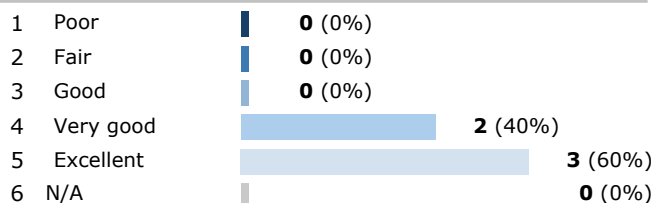
Instructors: **Michael Woodford**

Number of Participants: **14**

Enrollment of All Students: **15**

TA Graph Report for: **Silvio Ravaoli**

1 What is your overall assessment of the effectiveness of the teaching assistant? N=5



Median **5** Interpolated Median **4.67** Mean **4.60** Std Dev **0.55**

Title: **A&S Fall 2017 Standard Evaluation**

Course: **ECONW4850_001_2017_3 / Cognitive Mechanisms and Econ**

Instructors: **Michael Woodford**

Dates: **12/04/2017 - 12/14/2017**

Responses: **8/14 - 57.14%**

Number of Participants: **14**

Enrollment of All Students: **15**

TA Concise Report for: **Silvio Ravaoli**

	Poor	Fair	Good	Very good	Excellent	N/A	# of Responses	Median	Mean
							I-Median	St.Dev	
1 What is your overall assessment of the effectiveness of the teaching assistant?	0 0%	0 0%	0 0%	2 40%	3 60%	0 0%	5	5	4.60
								4.67	0.55

5 4.60
4.67 0.55

Title: **A&S Fall 2017 Standard Evaluation**Dates: **12/04/2017 - 12/14/2017**Course: **ECONW4850_001_2017_3 / Cognitive Mechanisms and Econ**Responses: **8/14 - 57.14%**Instructors: **Michael Woodford**Enrollment of Registered Students:**14**Enrollment of All Students:**15**

TA Comments Report for: **Silvio Ravaoli**

Q1 What are the strengths and weaknesses of your teaching assistant (discussion section leader, lab section leader, grader, or other assistant) as an instructor, and how might his or her teaching be improved?

- Strength: very patient, responsible for experiments, very responsive on Piazza and other communications
Weakness: None
 - Silvio is very patient and kind. I enjoyed his recitation very much and it helped me to understand lectures better.
 - Great TA - always approachable, responsive and helpful. Motivated and interested in the material, puts a lot of effort in answering all the questions and providing more information than expected.
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Columbia University: Arts & Sciences

A&S Spring 2019 Standard Evaluation

Course: ECONGU4260_001_2019_1-MARKETDESIGN
Instructor: Guillaume Haeringer
TA: Lan Nguyen,Silvio Ravaoli *
Response Rate: 59/76 (77.63 %)

1 - What are the strengths and weaknesses of Silvio Ravaoli (discussion section leader, lab section leader, grader) as an instructor, and how might Silvio Ravaoli's teaching be improved?

Response Rate 11/76 (14.47%)

- I thought Silvio was one of the best teaching assistants I've ever had. His recitations were great and very helpful.
- Silvio is a very smart TA who has perfect teaching skills. I couldn't ask for a better TA than Silvio since he always switched he way of explaining things if I didn't understand.
- Great section leader and highly capable at answering complex questions in a straightforward way.
- Silvio was always available and very friendly. His support made the class material easy to grasp and enjoyable to study.
- Silvio was awesome - carried me through the class, super nice, helpful and of course very thorough when covering the material
- Great guy
- Silvio was excellent in his recitation sections
- Excellent section leader. Understanding and flexible instructor.
- Responsive and is genuinely interested in the subject matter.
- Silvio is the best TA I have ever had. He truly cares if students understand the material. He goes above and beyond to prepare for office hours and recitation sections. It is incredible to see Silvio's passion and excitement for this course material--it makes his students excited to learn. Silvio's ability as a TA has impressed me. He has a clear natural talent for both economics and instruction.
- Silvio is an amazing TA! He is very happy to help, knows the material well, and was even willing to meet me outside of OH once because I had a class during his OH.

2 - What is your overall assessment of the effectiveness of Silvio Ravaoli?

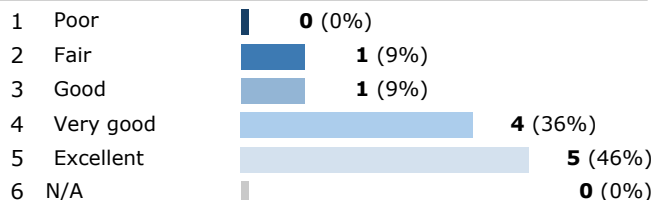
Response Option	Weight	Frequency	Percent	Percent Responses	Means			
Excellent	(5)	23	54.76%	<div></div>	4.29			
Very Good	(4)	11	26.19%	<div></div>				
Good	(3)	5	11.90%	<div></div>				
Fair	(2)	3	7.14%	<div></div>				
Poor	(1)	0	0.00%	<div></div>				
				0 25 50 100	Question			
Response Rate				Mean	STD		Median	
42/76 (55.26%)				4.29	0.94		5.00	

Title: **A&S Spring 2018 Standard Evaluation**
 Course: **ECONW4260_001_2018_1 / MARKET DESIGN**
 Instructors: **Guillaume G. Haeringer**

Dates: **04/23/2018 - 05/03/2018**
 Responses: **25/70 - 35.71%**
 Number of Participants: **70**
 Enrollment of All Students: **70**

TA Graph Report for: **Silvio Ravaoli**

1 What is your overall assessment of the effectiveness of the teaching assistant? N=11



Median **4** Interpolated Median **4.38** Mean **4.18** Std Dev **0.98**

Title: **A&S Spring 2018 Standard Evaluation**
 Course: **ECONW4260_001_2018_1 / MARKET DESIGN**
 Instructors: **Guillaume G. Haeringer**

Dates: **04/23/2018 - 05/03/2018**
 Responses: **25/70 - 35.71%**
 Number of Participants: **70**
 Enrollment of All Students: **70**

TA Concise Report for: **Silvio Ravaoli**

	Poor	Fair	Good	Very good	Excellent	N/A	# of Responses	Median	Mean
1 What is your overall assessment of the effectiveness of the teaching assistant?	0 0%	1 9%	1 9%	4 36%	5 45%	0 0%	11	4	4.18

4 4.18
4.38 0.98

Title: **A&S Spring 2018 Standard Evaluation**Dates: **04/23/2018 - 05/03/2018**Course: **ECONW4260_001_2018_1 / MARKET DESIGN**Responses: **25/70 - 35.71%**Instructors: **Guillaume G. Haeringer**Enrollment of Registered Students:**70**Enrollment of All Students:**70**

TA Comments Report for: **Silvio Ravaoli**

Q1 What are the strengths and weaknesses of your teaching assistant (discussion section leader, lab section leader, grader, or other assistant) as an instructor, and how might his or her teaching be improved?

- Amazing TA, always great at replying by email and in office hours. Great help throughout the course especially since the professor didn't hold office hours.
 - Very good
 - Not great at explaining things, but nice. Somewhat tough grader
 - His strength is patience. He takes time to respond to every question and makes it more fun and engaging.
 - Silvio is great. He is always willing to help you understand the material and problem set and is clearly dedicated to the class.
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Silvio Ravaioli – Syllabus – Behavioral Economics Course

Course Overview

This course provides an introduction to behavioral economics, the research field that combines economics tools with insights from psychology to better understand human behavior. Standard economic models assume that agents are perfectly rational, self-interested, and have unlimited cognitive resources. These assumptions are convenient for many economics applications, but suffer from severe limitations. Behavioral economists have documented ways in which standard models are systematically wrong in ways that are important to understand economic outcomes. Topics include choice under uncertainty, intertemporal preferences, social preferences, and bounded rationality. For each topic, I present the standard economic model, the behavioral model that generalizes the standard one, and I present (at least) one empirical application. Based on the target audience of the course, I can add a module focused on a relevant application (e.g., consumer behavior, behavioral finance, or behavioral development economics).

This syllabus would work well for an advanced undergraduate level course (each class/topic corresponds to one week), and can be adapted for a different target.

For an undergraduate course, the final assignment could be an essay, the analysis of the data from an existing dataset (e.g., from a published paper), or the research proposal for an experiment (if the class is small enough).

For a master or PhD level course, the syllabus can be augmented with more advanced papers; the assignments would be more focused on critical thinking of the recent literature, and it would include a referee report and a research proposal.

Topics and References

Textbook: David Just. Introduction to Behavioral Economics. Wiley Global Education, 2013.

Class 1 - Introduction to Behavioral Economics

- DellaVigna, Stefano. 2009. "Psychology and Economics: Evidence from the Field," *Journal of Economic Literature* 47(2): 315-372.

Class 2 – Heuristics and Biases

- Kahneman, D., and Frederick, S. (2005): "A Model of Heuristic Judgment" in K.J. Holyoak & R.G. Morrison [eds.], "Cambridge Handbook of Thinking and Reasoning," Cambridge University Press: 267-293.

Class 3 – Risk Preferences

- Rabin, M. (2002): "Diminishing Marginal Utility of Wealth Cannot Explain Risk Aversion," in D. Kahneman and A. Tversky [eds.], "Choices, Values and Frames," Cambridge University Press: 202-209.

Class 4 – Prospect Theory

- Kahneman, D., and A. Tversky (1979): "Prospect Theory: An analysis of decision under risk," *Econometrica*, 47: 263-291.

Class 5 – Applications of Prospect Theory

- Barberis, N. (2013): "Thirty Years of Prospect Theory in Economics: A Review and Assessment," *Journal of Economic Perspectives*, 27(1): 173-196

Class 6 – Time Preferences

- Frederick, S. (2006): "Valuing future life and future lives: A framework for understanding discounting," *Journal of Economic Psychology*, 27: 667-680.

Class 7 – Naïve Procrastination

- O'Donoghue, T., and Rabin, M. (2001). Choice and procrastination. *The Quarterly Journal of Economics*, 116(1), 121-160.

Class 8 - Temptation and Self-Control

- DellaVigna, S., and U. Malmendier (2004): "Contract Design and Self-Control," *Quarterly Journal of Economics*, 119(2): 353-402.

Class 9 – Bounded Rationality

- Johnson, E. J., and Ratcliff, R. (2013). Computational and process models of decision making in psychology and behavioral economics. *Neuroeconomics: Decision Making and the Brain*, edited by Paul W. Glimcher and Ernst Fehr, 35-48.

Class 10 – Satisficing and Consideration Sets

- Hauser, John R. "Consideration-set heuristics." *Journal of Business Research* 67.8 (2014): 1688-1699.

Class 11 – Applications of Bounded Rationality

- Gabaix, X. and D. Laibson (2006): "Shrouded Attributes, Consumer Myopia, and Information Suppression in Competitive Markets," *Quarterly Journal of Economics*, 121(2): 505-540.

Class 12 – Nudges and Choice Architecture

- Thaler Richard, H., & Sunstein Cass, R. (2008). Save more tomorrow. In *Nudge: Improving decisions about health, wealth, and happiness* (pp. 103-131).

Silvio Ravaoli – Syllabus - Consumer Behavior Course

Course Overview

This course provides a foundation the judgment and decision making aspects of consumer behavior, marketing, and business in general, including organizational behavior. The literature on judgment and decision making is vast and remarkably interdisciplinary. It borrows from and contributes to various fields, including economics, statistics, psychology, medicine, law, organizational behavior, and marketing. As a result, it covers a wide range of behavioral research relevant to the marketers, economists, and policy makers. Topics include basic consumer decision theory, mental accounting, multi-attribute choice, affect and decision making, process tracing, statistical decision making, context effects, and of course judgment heuristics.

This syllabus would work well for a graduate level course, and can be adapted for a different target.

An undergrad version of this class would focus more on the key concepts from behavioral economics and judgment and decision making literature, with applications on consumer behavior. For a PhD course with a small number of the students, the course can be more interactive with active discussions about the papers. The topics are also well suited for an MBA course, by focusing on case studies and applications.

Topics and References

Class 1 - Introduction to Consumer Decision Making

- Blackwell, Roger D., Paul W. Miniard and James F. Engel (2006), "The Consumer Decision Process," in Consumer Behavior, 10th Edition, Thomson South-Western; 67-97
- Simon, Herbert A. (1955), "A Behavioral Model of Rational Choice," Quarterly Journal of Economics, 69, 99-118.
- Hoyer, Wayne D. (1984), "An Examination of Consumer Decision-Making for a Common Repeat Purchase Product," Journal of Consumer Research, 11 (3), 822-29
- Hauser, J. R., & Wernerfelt, B. 1990. An Evaluation Cost Model of Consideration Sets. Journal of Consumer Research, 16(4): 393-408.
- Pham, Michel Tuan and Hannah Chang (2010), "Regulatory Focus, Regulatory Fit, and the Search and Consideration of Choice Alternatives," Journal of Consumer Research, 37 (December), 626-640

Class 2 - Process Models of Consumer Choice vs. Ability to Report on Processes

- Svenson, Ola (1979), "Process Descriptions of Decision Making," Organizational Behavior and Human Decision Processes, 23, 86-112.
- Payne, J. W., Bettman, J. R., & Johnson, E. J. (1988). Adaptive strategy selection in decision making. Journal of Experimental Psychology: Learning, Memory, and Cognition, 14(3), 534-552.
- Dawes, R.W. (1979), "The robust beauty of improper linear models in decision making," American Psychologist, 34(7), 571-582.
- Pham, Michel Tuan, Ali Faraji-Rad, Olivier Toubia, and Leonard Lee (2015), "Affect as an Ordinal System of Utility Assessment," Organizational Behavior and Human Decision Processes, 132 (November), 81-94.
- Nisbett, Richard E. and Timothy DeCamp Wilson (1977), "Telling More Than We Can Know: Verbal Reports on Mental Processes," Psychological Review, 84 (3), 231-259.

Class 3 - Choice Difficulty and Context Effects

- Iyengar, Sheena S., and Mark R. Lepper (2000), "When Choice is Demotivating: Can One Desire too Much of a Good Thing?" *Journal of Personality and Social Psychology*, 79(6): 995-1006
- Huber, Joel, John W. Payne, and Christopher Puto (1982), "Adding Asymmetrically Dominated Alternatives: Violations of Regularity and the Similarity Hypothesis," *Journal of Consumer Research*, 9 (June), 90-98
- Simonson, Itamar (1989), "Choice Based on Reasons: The Case of Attraction and Compromise Effects," *Journal of Consumer Research*, 16 (September), 158-174
- Wilson, Timothy D. and Jonathan W. Schooler (1991), "Thinking Too Much - Introspection Can Reduce the Quality of Preferences and Decisions," *Journal of Personality and Social Psychology*, 60(2): 181-192.
- Wood, Wendy and David T. Neal (2009), "The habitual consumer," *Journal of Consumer Psychology*, 19(4): 579-592.

Class 4 - Mental Accounting

- Arkes, Hal R., & Blumer, C. (1985), "The Psychology of Sunk Cost," *Organizational Behavior and Human Decision Processes*, 35(1): 124-140.
- Frederick, S., Novemsky, N., Wang, J., Dhar, R., & Nowlis, S. (2009), "Opportunity Cost Neglect," *Journal of Consumer Research*, 36(4): 553-561.
- Prelec, Drazen and George Loewenstein (1998), "The Red and the Black: Mental Accounting of Savings and Debt," *Marketing Science*, 17 (1), 4-28
- Cheema, Amar and Dilip Soman (2006), "Malleable mental accounting: The effect of flexibility on the justification of attractive spending and consumption decisions," *Journal of Consumer Psychology* 16 (1), 33-44.
- Zhou, Rongrong and Michel Tuan Pham (2004), "Promotion and Prevention across Mental Accounts: How Financial Products Dictate Consumers' Investment Goals." *Journal of Consumer Research*, Vol. 31 (June), 125-135.

Class 5 - Heuristics and Biases

- Oskamp, Stuart (1965), "Overconfidence in Case-Study Judgments," *Journal of Consulting Psychology*, 29 (3), 261-65.
- Langer, Ellen J. (1975), "Illusion of Control," *Journal of Personality and Social Psychology*, 32 (2), 311-28.
- Tversky, Amos and Daniel Kahneman (1974), "Judgment under Uncertainty - Heuristics and Biases," *Science*, 185 (4157), 1124-31
- Fischhoff, Baruch (1975). "Hindsight is not equal to foresight: The effect of outcome knowledge on judgment under uncertainty." *Journal of Experimental Psychology: Human perception and performance* 1.3 (1975): 288.
- Barhillel, Maya (1980), "The Base-Rate Fallacy in Probability Judgments," *Acta Psychologica*, 44 (3), 211-33

Class 6 – Biases and Debiasing

- Epley, Nicholas and Thomas Gilovich (2001), "Putting Adjustment Sack in the Anchoring and Adjustment Heuristic: Differential Processing of Self-Generated and Experimenter-Provided Anchors," *Psychological Science*, 12 (5), 391-96.

- Gigerenzer (1991), "How To Make Cognitive Illusions Disappear," in Wolfgang Stroebe and Miles Hewstone (eds.), *European Review of Social Psychology*, Vol. 2, 83-115.
- Kahneman and Tversky (1996), "On the Reality of Cognitive Illusions," *Psychological Review*, 103 (3), 582-591
- Faraji-Rad, Ali and Michel Tuan Pham (2017), "Uncertainty Increases the Reliance on Affect in Decisions," *Journal of Consumer Research*, 44 (June), 1-21.
- Arkes, Hal R. (1991), "Costs and Benefits of Judgment Errors: Implications for Debiasing," *Psychological Bulletin*, 110 (3), 486-498

Class 7 – Prospect Theory

- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, 263-291.
- Tom, S. M., Fox, C. R., Trepel, C., & Poldrack, R. A. (2007). The neural basis of loss aversion in decision-making under risk. *Science*, 315(5811), 515-518.
- Hardie, B. G., Johnson, E. J., & Fader, P. S. (1993). Modeling loss aversion and reference dependence effects on brand choice. *Marketing science*, 12(4), 378-394.
- Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and uncertainty*, 5(4), 297-323.
- Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. *Heuristics and biases: The psychology of intuitive judgment*, 49–81.
- Hertwig, R., & Erev, I. (2009). The description–experience gap in risky choice. *Trends in Cognitive Sciences*, 13(12), 517–523.

Class 8 – Time Preferences

- Malhotra, D., Loewenstein, G., & O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, 40(2), 351-401.
- Zauberman, G. (2003). The intertemporal dynamics of consumer lock-in. *Journal of consumer research*, 30(3), 405-419.
- Weber, E. U., Johnson, E. J., Milch, K. F., Chang, H., Brodscholl, J. C., & Goldstein, D. G. (2007). Asymmetric discounting in intertemporal choice: A query-theory account. *Psychological science*, 18(6), 516-523.
- Mogilner, C., & Aaker, J. (2009). "The time vs. money effect": Shifting product attitudes and decisions through personal connection. *Journal of Consumer Research*, 36(2), 277-291.

Class 9 – Consumer Finance

- Tufano, P. (2009). Consumer finance. *Rev. Financ. Econ.*, 1(1), 227-247.
- Navarro-Martinez, D., Salisbury, L. C., Lemon, K. N., Stewart, N., Matthews, W. J., & Harris, A. J. (2011). Minimum required payment and supplemental information disclosure effects on consumer debt repayment decisions. *Journal of Marketing Research*, 48(SPL), S60-S77.
- Fernandes, D., Lynch Jr, J. G., & Netemeyer, R. G. (2014). Financial literacy, financial education, and downstream financial behaviors. *Management Science*, 60(8), 1861-1883.
- Lusardi, A., & Tufano, P. (2009). Debt literacy, financial experiences, and overindebtedness (No. w14808). National Bureau of Economic Research.
- Goldstein, D. G., Johnson, E. J., & Sharpe, W. F. (2008). Choosing outcomes versus choosing products: Consumer-focused retirement investment advice. *Journal of Consumer Research*, 35(3), 440-456.

Class 10 – Behavioral Game Theory

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I attach sample teaching material that I created for the Market Design course (2019):

- Recitation slides (week 4, auctions);
- Recitation slides (week 11, matching);
- Notes on theorems and proofs (review for the final exam).

[†] Department of Economics, Columbia University; e-mail: sr3300@columbia.edu; website: silvioravaioli.com.

Auctions

ECON GU4260 MARKET DESIGN - Recitation 4

Silvio Ravaoli

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Question 1

Question 1

Describe an ascending auction where the auctioneer announces the price (not the bidders) and the speed at which bidders bid matters.

Exercise 1

Speed obviously matters in an English outcry auction.

If two bidders want to place (i.e., announce) the same bid the bidder who will officially place the bid will be the first one to do so.

For an ascending auction where the auctioneer announces the price we can do the following:

- The auctioneer announces a price.
- The bidders just have to say OK to the auctioneer. It suffices that one bidder says OK for the auctioneer to announce a higher price.
- If the auction stops at that price (i.e., for the next price nobody says OK), then the winner is the bidder who said OK at the previous price.

Exercise 1

For instance, two bidders, Alice and Bob, have the same highest valuation, say equal to \$10.

Suppose that at \$10 Alice is faster saying OK.

At \$11 nobody says OK so the auction stops. Alice is the winner.

In this case, Alice wins the auction for sure since she is the fastest, whereas in a Japanese auction Alice and Bob would have the same probability of winning. The auctioneer is announcing the price in both cases, but the speed of bids is important only in the former.

Question 2

Question 2

The English and the Vickrey auctions are strategically equivalent, and the revenue for the seller is the same. Yet, in terms of the *information* received by the seller/auctioneer they are different. What is this difference?

Question 2

Hint

Think it terms of what the auctioneer knows before and after the auction.

To be exact, there are some cases where there is no difference between these two auction formats and some cases (more common) where there is a difference.

In your answer mention under which condition this occurs.

Exercise 2

If there is only one bidder with the “highest” valuation, then in the English auction the auctioneer will never learn that valuation: the auction will stop just above the second highest valuation. In contrast, in the Vickrey auction the auctioneer does learn the valuation of all the bidders.

There is a case when the auctioneer can learn the highest bidder's valuation in the English auction: it's when there are several bidders with the same highest valuation. In that case all those bidders stop bidding at the same price. The winner will be chosen at random among those bidders, but the auctioneer eventually learns their valuation.

Question 3

Question 3

Most bidders focus on focal amounts when bidding on eBay: multiple of \$10 or \$5, or simply integers. Alice is a bidder that uses the following strategy: whenever she comes up with a integer for a bid, she adds one penny. So, when she decides to bid, say, \$10 or \$25 she instead bids \$10.01 or \$25.01, respectively.

Bob has a strategy similar to that of Alice, but instead of adding one penny he adds a random amount between 40 and 70 pennies. So, when he decides to bid \$10 or \$25 he instead bids \$10.56 or \$25.47.

Why do you think Alice and Bob adopt such strategies?

Exercise 3

If two or more bidders bid the same amount, then eBay will use a time priority rule: the earliest bid wins.

Since many bidders choose integer values, if Alice wants to bid, say, \$50, she knows that she may not be the first bidder. For her bidding \$50 or \$50.01 is the same, so bidding \$50.01 is for her a way to bid \$50 but being sure that she's always first among the bidders who bid \$50.

Exercise 3

However, Bob knows that:

- (a) Most bidders bid integers.
- (b) Some bidders like Alice always add a 1 penny to their bid to outbid bidders in category (a).

So the only way to outbid bidders in categories (a) and (b) is to do the same as Alice, but adding more pennies.

Question 4

Question 4

A **uniform price auction** is an auction where all the goods sold through the auction (or units of the good) are sold at the same price.

Suppose there are k units of a good to be sold, and each bidder wants at most 1 unit of the good. We run a $(k+1)$ -th price, uniform price auction. That is, the k highest bidders win and they all pay the same price, the $(k+1)$ -th bid.

We assume that there are at least $k+1$ bidder, $k \geq 2$ (we've seen in class the case when $k = 1$).

In this auction, is it a dominant strategy to bid one's valuation? If yes, provide a sketch of the proof. If not, provide an example.

Exercise 4

This auction fits the VCG auction. Label the k units as x_1, x_2, \dots, x_k . Define for each bidder i the following valuation *function*,

$$v_i(S, b) = \begin{cases} b & \text{if } S = \{x_h\}, h = 1, \dots, k \\ 0 & \text{otherwise} \end{cases}$$

That is, bidder i values the assignment b if S contains only one element, i.e., one copy of the good. If S is empty or it contains more than one element, then i values S at 0.

Take the $(k + 1)$ -th uniform price auction with k winners, and let (b_1, b_2, \dots, b_n) be the bids of the bidders. Now take the VCG auction where each bidder i bids the value function $v_i(\cdot, b_i)$.

Exercise 4

It is easy to see that the assignment that maximizes the social value is the one that assigns the good to the k bidders with the highest b , and the price paid by each bidder (being assigned a copy of the good) is the $(k + 1)$ -th highest b .

In other words, the outcome of the $(k + 1)$ -th uniform price auction with k winners is the same as the VCG auction (with the same bids).

In any VCG auction it is a dominant strategy to submit one's true valuation, so it is also the case in the $(k + 1)$ -th uniform price auction with k winners.

This result is obtained by the adoption of a $(k + 1)$ -th price auction with k units. Would it still hold if we had a k -th price auction instead?

Question 5

Question 5

The table below shows the valuations of three goods (x , y and z) for three bidders (a , b and c). Find the allocation and the prices paid by each bidder with the VCG auction.

Bidder's valuation			
	a	b	c
x	7	2	4
y	5	3	5
z	6	1	6
xy	9	6	9
xz	10	7	10
yz	11	8	11
xyz	15	15	15
nothing	0	0	0

Exercise 5

Assignment			Social value						
a	b	c	a	b	c	abc	a+b	a+c	b+c
x	nothing	yz	7	0	11	18	7	18	11
x	y	z	7	3	6	16	10	13	9
xyz	nothing	nothing	15	0	0	15	15	15	0
yz	nothing	x	11	0	4	15	11	15	4
xz	nothing	y	10	0	5	15	10	15	5
xy	nothing	z	9	0	6	15	9	15	6
x	yz	nothing	7	8	0	15	15	7	8
z	nothing	xy	6	0	9	15	6	15	9
y	nothing	xz	5	0	10	15	5	15	10
nothing	xyz	nothing	0	15	0	15	15	0	15
nothing	nothing	xyz	0	0	15	15	0	15	15

Exercise 5

value for b & c at the optimal assignment 11

max value for b & c when a not present 15

value for a & c at the optimal assignment 18

max value for a & c when b not present 18

value for a & b at the optimal assignment 7

max value for a & b when c not present 15

Bidder	a	b	c
Assignment	x	nothing	yz
Price	4	0	8

Assignment problems

ECON GU4260 MARKET DESIGN - Recitation 11

Silvio Ravaoli

April 25, 2019

Definition of Core

Intuition

The core is the set of feasible assignments that cannot be improved upon by a subset (coalition) of individuals.

Definition

The core of an assignment problem is the set of all assignments μ such that there is no coalition S of individuals and an assignment μ' for which:

1. For each individual $i \in S$, the object $\mu'(i)$ is the endowment of another individual in S ;
2. Each individual in S is indifferent or prefers μ' to μ and there is at least one individual who strictly prefers μ' to μ .

Core and stability

We want to explore the intuitive connection between *core* in an assignment problem and *stability* in a matching problem.

We will focus on assignment problems without monetary transfers, but for sake of clarity we can start with two classic examples in cooperative game theory that involve money.

We want to apply the definition of core in these particular cases.

Core Example 1: Selling gloves

Alice and Bob are knitting gloves. All the gloves are identical, and two gloves make a pair that they sell for \$5. They have each made three gloves. How can they share the revenues from the sale?

We want to describe the whole **set of possible ways to share the revenues**, and not only the obvious case (7.5, 7.5). We know that together they get \$15, and this is the maximum amount they can share. Every singleton coalition (consisting of a single person) can provide \$5, so it would not be individually rational to accept anything less than \$5.

It follows that the core is represented by all the possible distributions (π_A, π_B) such that $\pi_A + \pi_B = 15$ and $\pi_A \geq 5, \pi_B \geq 5$. For instance (5, 10), (7, 8), and (7.5, 7.5) belong to the core.

Core Example 2: Selling shoes

Alice, Bob, and Carol produce shoes: Alice has one left shoe, Bob and Carol have one right shoe each (suppose there is no cost for material or production). A pair of shoes consists of a left and a right shoe, which can then be sold for \$10. How can they share the revenues from the sale?

The core of this game consists of a unique possible way to distribute the revenues: we give \$10 to Alice who has a (scarce) left shoe [her inclusion in a coalition always “creates” \$10], and \$0 to Bob and Carol, owning an (oversupplied) right shoe (a right shoe alone has no value). No coalition can block this assignment, because Alice will not accept less than 10, and any distribution that pays a positive amount to any right shoe owner must pay less than 10 to Alice. So, there is just one possible assignment in the core: Alice \$10, Bob \$0, Carol \$0.

Core in general equilibrium theory

In class we also mentioned the interpretation of the core in a competitive (Walrasian) equilibrium.

The competitive equilibrium of a pure exchange economy (without production) in a general equilibrium model represents an allocation of the resources available and it is usually represented with an Edgeworth box when we have a two-agent economy (but remember that in general the concept of equilibrium also requires the definition of prices).

The **equilibria** lie in the **core** of the cooperation game between the agents. Graphically, the core is the set of points on the contract curve (the set of Pareto optimal allocations) lying between each of the agents' indifference curves defined at the initial endowments.

Core in the marriage model

A matching μ is **stable** if it cannot be improved upon by any individual (individual rationality) or any pair of agents (absence of blocking pairs). **Unstable** matchings are those dominated via coalitions consisting of individuals or pairs, and so unstable matchings are not in the core of the game.

We defined the core as the set of matchings undominated by coalitions of any size, and so the set of stable matchings might *strictly* contain the core. For one-to-one matchings, this cannot be the case.

Theorem

The core of the marriage market equals to the set of stable matchings.

Core in the marriage model - Proof

Theorem

The core of the marriage market equals to the set of stable matchings.

This theorem does not require assuming strict preference: it holds even when agents are indifferent between multiple alternatives.

(1) μ not stable $\Rightarrow \mu \notin \text{core}$

A matching can be not stable because of failure in individual rationality or existence of a blocking pair.

If μ is not individually rational, then it is dominated via a singleton coalition, and if it is unstable via some blocking pair (m, w) with $mP_w\mu(w)$ and $wP_m\mu(m)$, then it is dominated via the coalition (m, w) by any matching μ' with $\mu'(m) = w$.

So if μ is not stable, it cannot be in the core.

Core in the marriage model - Proof

Theorem

The core of the marriage market equals to the set of stable matchings.

(2) μ not stable $\Leftarrow \mu \notin \text{core}$

If μ is not in the core, then it is dominated by some matching μ' via a coalition S , with at least one member of the coalition strictly preferring μ' . Without loss of generality, we consider the case in which at least one woman w' strictly prefers $\mu'(w')$ to $\mu(w')$, and every woman w in S weakly prefers $\mu'(w)$ to $\mu(w)$ [note that it is symmetrical to the case with at least one man strictly preferring μ']. If μ is individually rational, this implies $\mu'(w') = m' \in S$. Then m' prefers w' to $\mu(m')$ and μ is blocked by (m', w') . So if μ is not in the core, it cannot be stable.

Note that in the more general models of many-to-one matching the set of stable matchings can strictly contain the core.

Existence and uniqueness of assignments in the core

We are interested in verifying whether we have at least (and at most) one assignment in the core.

We separately consider three major cases we discussed:

- assignment problem with private endowment
- assignment problem with public endowment
- one-to-one matching problem

Remember that we are assuming strict preferences (no indifference). This assumption is crucial when we explore the existence/uniqueness properties of the assignments in the core.

- **Assignment problem with private endowment**

- The core is not empty (existence)
- In particular, it is always a singleton (uniqueness)

- **Assignment problem with public endowment**

- The concept of core is not useful in this case!
- We cannot have a blocking coalition if the agents do not have an initial *private* endowment
- Since we cannot operate any refinement, the core simply coincides with the whole set of feasible assignments (existence, but not uniqueness)

- **One-to-one matching problem** (e.g. marriage problem)

- The core is not empty (existence)
- From the theorem above, the core represents the set of stable matches
- But we can have multiple stable matchings (not uniqueness)

Efficiency vs Core

This example shows that efficient assignments do not necessarily lie in the core (initial endowment indicated by asterisk).

Alice	Bob	Carol
B	A	A
C	B*	B
A*	C	C*

- The assignment $\mu(Alice) = C$, $\mu(Bob) = B$, $\mu(Carol) = A$ is efficient but not in the core (Alice and Bob can be better off).
- An assignment is *efficient* if it is not possible to make **any agent** better off without making **someone else** worse off.
- An assignment is in the *core* if it is not possible to make **any member of a coalition** better off without making **any of its members** worse off.

- When all the agents have a private endowment, an assignment in the core implies efficiency:
- If no coalition (of any size) is able to make all the members weakly better off, this must also apply to the whole group.
- In case of public endowment, or mixed endowments, this is not necessarily true. We saw that the MIT assignment algorithm can generate a Pareto dominated assignment that is not blocked by any coalition (Chapter 11, Slide 32)

Top Trading Cycle

Two important theorems about TTC

- ① The assignment produced by TTC is the unique core assignment (Roth and Postlewaite 1977).
- ② An assignment mechanism is strategyproof, Pareto efficient, and individually rational if and only if it is TTC (Ma 1994).

Sketch of the proof of Roth and Postlewaite theorem:

- The TTC algorithm finds an assignment μ that is in the core
- We want to show that there is no other core assignment
- Suppose there is another core assignment ν and consider a , the “first” agent (based on TTC order) who gets a different good $\nu(a) \neq \mu(a)$
- Consider the coalition of agents who traded the goods in the cycle that included agent a
- This is a blocking coalition for ν , as they own all the goods that they will exchange, so ν is not in the core

Top Trading Cycle

The properties we listed above do not hold if we do not have private endowments. Consider these preferences:

$$P(\text{Alice}) = a, b, c, \emptyset$$

$$P(\text{Bob}) = b, a, c, \emptyset$$

$$P(\text{Carol}) = b, c, a, \emptyset$$

Without initial endowment we can have multiple core assignments (for instance a-b-c and b-a-c) and also core assignments that are not efficient (such as b-a-c, that is dominated by a-b-c).

Pin down any initial endowment (e.g. b-c-a) and run the TTC. Check whether the assignment is 1) efficient, 2) in the core, and 3) the unique core assignment.

Now use a different initial endowment (e.g. c-b-a) and repeat.

Market Design - Three theorems you should know

Silvio Ravaoli

If μ and μ' are two stable matchings such that all men prefer μ to μ' then all women prefer μ' to μ .

We consider the marriage problem (one-to-one matching) between men and women. Let μ and μ' be two stable matchings [i.e. individually rational and without blocking pairs]. Suppose that *all* men prefer μ to μ' . We want to prove that it then must be that *all* women prefer μ' to μ . We can prove this by contradiction.

- Suppose there is a woman \hat{w} who prefers μ to μ' , i.e., $\mu(\hat{w})P_{\hat{w}}\mu'(\hat{w})$.
- Define \hat{m} her match in μ , i.e., $\hat{m} := \mu(\hat{w})$.
- By assumption, for every man $\mu(m)P_m\mu'(m)$.
- So this is true also for \hat{m} , and we write $\hat{w} = \mu(\hat{m})P_{\hat{m}}\mu'(\hat{m})$.
- Since $\mu(\hat{w}) = \hat{m}$ we also have $\hat{m} = \mu(\hat{w})P_{\hat{w}}\mu'(\hat{w})$.
- So (\hat{m}, \hat{w}) block μ' and thus μ' is not stable, a contradiction.
- So there is no woman who prefers μ to μ' .

The serial dictatorship always gives efficient assignments.

We consider the assignment problem with a given order of individuals (dictators). Let μ be the assignment obtained with the serial dictatorship (SD) algorithm. We want to prove that μ is efficient, i.e. there exist no other feasible assignment where every individual is weakly better off and at least one strictly better off with respect to μ . We can prove this by contradiction.

- Suppose μ is not efficient.
- This means there is another assignment μ' that makes some individuals better off (and leaves others indifferent).

- Consider the set of dictators who strictly prefer μ' to μ , and let a be the first dictator in the sequence who prefers $\mu'(a)$ to $\mu(a)$.
- All the dictators who chose before a obtain the same object with μ and μ' .
- When we run the SD algorithm, in a 's turn to choose, the object $\mu'(a)$ is available: it is not taken by any individual who chose before her.
- But that contradicts the fact that a picks $\mu(a)$ with the SD rule when we construct μ . If $\mu'(a)P_a\mu(a)$, she must choose $\mu'(a)$ when it is her turn.
- This contradicts the assumption that a prefers $\mu'(a)$ to $\mu(a)$, and thus μ is efficient.

The Deferred Acceptance algorithm always gives stable matchings.

We consider the marriage problem (one-to-one matching) between men and women. Without loss of generality, let μ be the matching obtained by running men-proposing DA [the analysis is similar when women propose]. We want to prove that μ is stable [i.e. individually rational and without blocking pairs] for any number of agents, and for any possible preferences that the agents can have. We can prove this by contradiction, by considering separately the two cases. Note that the proof requires you to remember how the DA algorithm proceeds.

1) Show that μ must be individually rational.

- Suppose that μ is not individually rational.
- This means there is a man \hat{m} who is matched to an unacceptable woman \hat{w} , i.e., $\hat{w} = \mu(\hat{m})P_{\hat{m}}\hat{m}$.
- Therefore during the algorithm \hat{m} has been rejected by all the women he prefers to himself (if any), and thus there is a step at which there was no acceptable women he has not yet proposed to.
- In this case, the algorithm says that the man remains single; he cannot propose to another woman.

- But for \hat{m} and \hat{w} to be matched, it must be that at some step he proposed to her. We just explained that this is impossible, so a man cannot end up being matched to an unacceptable woman.
- Similarly, a woman cannot be matched to an unacceptable man. The description of the algorithm makes it clear that a woman always rejects offers from unacceptable man.
- Therefore, the matching constructed by the Deferred Acceptance algorithm is necessarily individually rational.

2) Show that μ cannot have blocking pairs.

- Suppose that in μ there is a blocking pair (\hat{m}, \hat{w}) .
- This means they both prefer each other to their match under μ .
- For \hat{m} to be matched to $\mu(\hat{m})$, it must be that he proposed $\mu(\hat{m})$ at some step of the algorithm.
- If \hat{m} wants to block with \hat{w} , it must be that $\hat{w} P_{\hat{m}} \mu(\hat{m})$.
- Since \hat{m} ends up not being matched to \hat{w} , it must be that at some step she rejected him.
- A woman only rejects an offer if she has a better one (according to her preferences). So if \hat{w} rejected an offer from \hat{m} , it must be that she had, at some step, an offer from a man she prefers to \hat{m} .
- Therefore \hat{w} is eventually matched with a man that she prefers to \hat{m} , so the pair (\hat{m}, \hat{w}) cannot block, and thus there cannot be any blocking pair in the matching constructed by the Deferred Acceptance algorithm.