

## GAME THEORY: INFORMATION DESIGN

### **Class Description**

Most economics consider an agent's behavior driven by preferences and information. If we wish to influence the agent's choice, there are two ways. The first one is to affect incentives by using contingent rewards and punishments (contract or mechanism design). The second one is to provide information (persuasion or information design). This course mainly surveys the recent developments in the growing literature about information design. We will also cover some classic results from information theory as well as a variety of applications in finance, industrial organization, labor and personnel economics, law and economics, and political economy. The course is designed for Ph.D. students interested in doing theoretical research on related topics or receiving formal training to develop modeling skills for applied work. The course has two parts. The first part focuses on the theoretical foundation of information design, and the second part is devoted to applying these tools to study information and pricing, consumer privacy, optimal rating design, and information policies of platforms.

### **Class Requirements**

The course is reading-intensive. Grades for the class will be based on:

- class participation
- in-class presentation
- research proposal

### **Class Logistics**

We meet in person on Tuesday and Thursday from 3:30 pm to 4:45 pm.

### **Contacting Us**

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### **Background Reading**

- A. Kamenica, Emir. "Bayesian persuasion and information design." *Annual Review of Economics* 11 (2018)
- B. Bergemann, Dirk, and Stephen Morris. "Information design: A unified perspective." *Journal of Economic Literature* 57, no. 1 (2019): 44-95.

## Tentative Schedule <sup>1</sup>

### 1. Information Theory (1 week)

- (1) Blackwell, David. "Comparison of Experiments." In Proceedings of the Second Berkeley Symposium on Mathematical Statistics and Probability. The Regents of the University of California, 1951.\*
- (2) de Oliveira, Henrique. "Blackwell's informativeness theorem using diagrams." *Games and Economic Behavior* 109 (2018): 126-131.\*
- (3) Lehmann, Erich Leo. "Comparing location experiments." In *Selected Works of EL Lehmann*, pp. 779-791. Boston, MA: Springer US, 2011.
- (4) Kim, Yonggyun. "Comparing information in general monotone decision problems." *Journal of Economic Theory* (2023): 105679.

### 2. Concavification Approach (2 weeks)

- (1) Kamenica, Emir, and Matthew Gentzkow. "Bayesian persuasion." *American Economic Review* 101, no. 6 (2011): 2590-2615.\*
- (2) Alonso, Ricardo, and Odilon Câmara. "Persuading voters." *American Economic Review* 106, no. 11 (2016): 3590-3605.
- (3) Alonso, Ricardo, and Odilon Camara. "Bayesian persuasion with heterogeneous priors." *Journal of Economic Theory* 165 (2016): 672-706.
- (4) Galperti, Simone. "Persuasion: The art of changing world views." *American Economic Review* 109, no. 3 (2019): 996-1031.
- (5) Lipnowski, Elliot, and Doron Ravid. "Cheap talk with transparent motives." (2020). *Econometrica*.
- (6) Ely, Jeffrey C., and Martin Szydlowski. "Moving the goalposts." *Journal of Political Economy* 128, no. 2 (2020).\*
- (7) Lin, Xiao, and Ce Liu. "Credible Persuasion." (2023). *Journal of Political Economy*, forthcoming.
- (8) Doval, Laura, and Alex Smolin. "Persuasion and Welfare." (2023). *Journal of Political Economy*, forthcoming.

### 3. BCE Approach (2 weeks)

- (1) Aumann, Robert J. "Correlated equilibrium as an expression of Bayesian rationality." *Econometrica: Journal of the Econometric Society* (1987): 1-18.
- (2) Bergemann, Dirk, and Stephen Morris. "Bayes correlated equilibrium and the comparison of information structures in games." *Theoretical Economics* 11, no. 2 (2016): 487-522.\*

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<sup>1</sup> Papers marked with (\*) will be covered in lectures; while papers marked with (#) are available for presentation.

- (3) Taneva, Ina. "Information design." *American Economic Journal: Microeconomics*, 11, no. 4 (2019): 151-85.\*
- (4) Bergemann, Dirk, Benjamin Brooks, and Stephen Morris. "First-Price Auctions With General Information Structures: Implications for Bidding and Revenue." *Econometrica* 85, no. 1 (2017): 107-143.
- (5) Bergemann, Dirk, Alessandro Bonatti, and Alex Smolin. "The design and price of information." *American Economic Review* 108, no. 1 (2018): 1-48.
- (6) Doval, Laura, and Jeffrey C. Ely. "Sequential information design." *Econometrica* 88, no. 6 (2020): 2575-2608.
- (7) Makris, Miltiadis, and Ludovic Renou. "Information design in multi-stage games." *arXiv preprint arXiv:2102.13482* (2021).
- (8) Morris, Oyama and Takahashi. "Adversarial Information Design in Binary-Action Supermodular Games" working paper (2023).

#### 4. Posterior-Mean Approach (2 weeks)

- (1) Rothschild, Michael, and Joseph E. Stiglitz. "Increasing risk: I. A definition." *Journal of Economic theory* 2, no. 3 (1970): 225-243.\*
- (2) Leshno, Moshe, Haim Levy, and Yishay Spector. "A Comment on Rothschild and Stiglitz's "Increasing Risk: I. A Definition"." *Journal of Economic Theory* 77, no. 1 (1997): 223-228.
- (3) Gentzkow, Matthew, and Emir Kamenica. "A Rothschild-Stiglitz approach to Bayesian persuasion." *American Economic Review* 106, no. 5 (2016): 597-601.\*
- (4) Kolotilin, Anton, Tymofiy Mylovanov, Andriy Zapechelnyuk, and Ming Li. "Persuasion of a privately informed receiver." *Econometrica* 85, no. 6 (2017): 1949-1964.
- (5) Kolotilin, Anton. "Optimal information disclosure: A linear programming approach." *Theoretical Economics* 13, no. 2 (2018): 607-635.
- (6) Dworzak, Piotr, and Giorgio Martini. "The simple economics of optimal persuasion." *Journal of Political Economy* 127, no. 5 (2019): 1993-2048.\*
- (7) Dizdar, Deniz, and Eugen Kováč. "A simple proof of strong duality in the linear persuasion problem." *Games and Economic Behavior* 122 (2020): 407-412.
- (8) Dworzak, Piotr, and Anton Kolotilin. "The persuasion duality." *arXiv preprint arXiv:1910.11392* (2019).
- (9) Kleiner, Andreas, Benny Moldovanu, and Philipp Strack. "Extreme points and majorization: Economic applications." *Econometrica* 89, no. 4 (2021): 1557-1593.\*

#### 5. Other Approaches (if time permits)

- (1) Yang, Kai Hao, and Alexander K. Zentefis. "Extreme Points of First-Order Stochastic Dominance Intervals: Theory and Applications." *arXiv preprint arXiv:2302.03135* (2023).

- (2) Smolin, Alex, and Takuro Yamashita. "Information Design in Games: Certification Approach." (2023).
- (3) Kolotilin, Anton, Roberto Corrao, and Alexander Wolitzky. "Persuasion and Matching: Optimal Productive Transport." (2023).

## 6. Information and Pricing (2 weeks)

- (1) Roesler, Anne-Katrin, and Balázs Szentes. "Buyer-optimal learning and monopoly pricing." *American Economic Review* 107, no. 7 (2017): 2072-80. \*
- (2) Armstrong, Mark, and Jidong Zhou. "Consumer information and the limits to competition." *American Economic Review* 112, no. 2 (2022): 534-577.\*
- (3) Hwang, Ilwoo, Kyungmin Kim, and Raphael Boleslavsky. "Competitive Advertising and Pricing." Working Paper (2019).
- (4) Anderson, Simon P., and Régis Renault. "Advertising content." *American Economic Review* 96, no. 1 (2006): 93-113.
- (5) Choi, Michael, Kyungmin Kim, and Marilyn Pease. "Optimal information design for search goods." In *AEA Papers and Proceedings*, vol. 109, pp. 550-556. 2014.
- (6) Lyu, Chen. "Information design for selling search goods and the effect of competition." *Journal of Economic Theory* 213 (2023): 105722.
- (7) Bergemann, Dirk, Benjamin Brooks, and Stephen Morris. "Search, information, and prices." *Journal of Political Economy* 129, no. 8 (2021): 2275-2319.
- (8) Au, Pak Hung, and Mark Whitmeyer. "Attraction versus persuasion: Information provision in search markets." *Journal of Political Economy* 131, no. 1 (2023): 202-245.\*

## 7. Market Segmentation and Privacy (2 weeks)

- (1) Bergemann, Dirk, Benjamin Brooks, and Stephen Morris. "The limits of price discrimination." *American Economic Review* 105, no. 3 (2015): 921-57.
- (2) Yang, Kai Hao. "Selling Consumer Data for Profit: Optimal Market-Segmentation Design and its Consequences." 2019
- (3) Elliott, Matthew, Andrea Galeotti, Andrew Koh, and Wenhao Li. "Market segmentation through information." *Available at SSRN 3432315* (2021).
- (4) Haghpanah, Nima, and Ron Siegel. "Pareto-Improving Segmentation of Multiproduct Markets." *Journal of Political Economy* 131, no. 6 (2023): 000-000.
- (5) Haghpanah, Nima, and Ron Siegel. "A Theory of Stable Market Segmentations." *arXiv preprint arXiv:2210.13194* (2022).
- (6) Ali, S. Nageeb, Greg Lewis, and Shoshana Vasserman. "Voluntary disclosure and personalized pricing." *The Review of Economic Studies*, Volume 90, Issue 2, March 2023, Pages 538–571.
- (7) Simone Galperti, Aleksandr Levkun, Jacopo Perego, The Value of Data Records, *The Review of Economic Studies*, 2023, rdad044

8. Rating Design (1 week)

- (1) Lizzeri, Alessandro. "Information revelation and certification intermediaries." *The RAND Journal of Economics* (1999): 214-231.
- (2) Ali, S. Nageeb, Nima Haghpanah, Xiao Lin, and Ron Siegel. "How to sell hard information." *The Quarterly Journal of Economics* 137, no. 1 (2022): 619-678.
- (3) Garcia, Daniel, and Matan Tsur. "Information design in competitive insurance markets." *Journal of Economic Theory* 191 (2021): 105160.

9. Information Policy in Platform (1 week)

- (1) Choi, Jay Pil, Kyungmin Kim, and Arijit Mukherjee. "'Sherlocking'and Information Design by Hybrid Platforms." *Available at SSRN 4332558* (2023).