Topics in Economic Theory: AI-Driven Market Dynamics

Naples Ph.D. in Economics: Spring 2025

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1 Overview

Introduction. The rise of artificial intelligence and algorithmic decision-making is transforming how firms compete in markets. Pricing algorithms manage billions of dollars in revenue in retail, travel, and financial markets. AI bidding agents increasingly dominate online advertising auctions and wholesale electricity markets. These developments raise important questions about market efficiency, competition policy, and economic welfare.

This course examines cutting-edge research at the intersection of economics, computer science, and artificial intelligence. We begin with the essential background on algorithmic competition and market design considerations for AI agents. The core sections then progress from theoretical foundations in reinforcement learning and regret minimization to simulation studies of algorithmic pricing behavior, theoretical models of AI competition, empirical evidence from various markets, and novel structural estimation approaches for analyzing AI agents. A key theme throughout is understanding how algorithmic decision-makers may achieve anti-competitive outcomes even without explicit coordination.

Prerequisites. This advanced Ph.D. course builds on first-year microeconomic theory and econometric sequences. Students should be comfortable with game theory, industrial organization, and empirical methods. Although not strictly required, familiarity with computer science concepts—particularly algorithmic game theory, complexity theory, and basic machine learning—will be valuable for engaging with the technical material. The course combines rigorous theoretical analysis with practical applications and empirical evidence.

Requirements. There will be two meetings, each lasting approximately 3 hours. I will distribute slides before each meeting. Students are expected to:

- Attend all meetings.
- Select one paper marked with [**SP**] to read and present at the second meeting.
- Select one paper marked with [**SP**] to read and write a referee report on.

I will help you select the two papers from the references above for your readings based on your research interests.

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2 Topics and Readings

I will provide an introduction to topics 1 and 2. For topics 3–6, [**C**] indicates the papers that I will discuss in class, and [**SP**] the papers suggested for students' presentations.

1. Background Readings

- Assad, Calvano, Calzolari, Clark, Denicolò, Ershov, Johnson, Pastorello, Rhodes, Xu, and Wildenbeest (2021). "Autonomous Algorithmic Collusion: Economic Research and Policy Implications." *Oxford Review of Economic Policy.*
- Banchio and Skrzypacz (2022). "Market Design for AI Algorithms." *ACM SIGecom Exchanges.*
- Chassang and Ortner (2023). "Regulating Collusion." *Annual Review of Economics.*
- Harrington (2018). "Developing Competition Law for Collusion by Autonomous Artificial Agents." *Journal of Competition Law & Economics.*

2. Algorithmic Learning Models: Reinforcement Learning & Regret Minimization

- Albrecht, Christianos, and Schäfer (2024). "Multi-Agent Reinforcement Learning: Foundations and Modern Approaches." *MIT Press.*
- Nisam, Roughgarden, Tardos, and Vazirani (2016). "Algorithmic Game Theory." *Cambridge University Press.*
- Roughgarden (2016). "Twenty Lectures on Algorithmic Game Theory." *Cambridge University Press.*
- Shoam and Leyton-Brown (2008). "Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations." *Cambridge University Press.*
- Sutton and Barto (2018). "Reinforcement Learning: An Introduction." MIT Press.

3. Simulations

- Abada and Lambin (2023). "Artificial Intelligence: Can Seemingly Collusive Outcomes be Avoided?" *Management Science.* [**SP**]
- Asker, Fershtman, and Pakes (2024). "The Impact of Artificial Intelligence Design on Pricing." *Journal of Economics & Management Strategy.* [**C**]
- Calvano, Calzolari, Denicolò, and Pastorello (2020). "Artificial Intelligence, Algorithmic Pricing, and Collusion." *The American Economic Review.* [**C**]
- Fish, Gonczarowski, and Shorrer (2024). "Algorithmic Collusion by Large Language Models." *Working Paper.* [**SP**]
- Klein (2021). "Autonomous Algorithmic Collusion: Q-learning under Sequential Pricing." *The RAND Journal of Economics.* [**SP**]

4. Theory

- Askenazi-Golan, Mergoni Cecchelli, and Plumb (2024). "Reinforcement Learning, Collusion, and the Folk Theorem." *Working Paper.* [**SP**]
- Banchio and Mantegazza (2024). "Artificial Intelligence and Spontaneous Collusion." *Working Paper.* [**C**]
- Cho and Williams (2024). "Collusive Outcomes Without Collusion: Algorithmic Pricing in a Duopoly Model." *Working Paper.* [**SP**]
- Hansen, Misra, and Pai (2021). "Frontiers: Algorithmic Collusion: Supra-competitive Prices via Independent Algorithms." *Marketing Science.* [**SP**]
- Lamba and Zuck (2024). "Pricing with Algorithms." *Working Paper.* [**SP**]
- Possnig (2024). "Reinforcement Learning and Collusion." *Working Paper.* [**SP**]
- Salcedo (2015). "Pricing Algorithms and Tacit Collusion." *Working Paper.* [**C**]

5. IO Aspects of Algorithmic Competition

- Brown and MacKay (2023). "Competition in Pricing Algorithms." *American Economic Journal: Microeconomics.* [**SP**]
- Harrington (2022). "The Effect of Outsourcing Pricing Algorithms on Market Competition." *Management Science.* [**SP**]
- Ichihashi and Smolin (2024). "Buyer-Optimal Algorithmic Consumption." *Working Paper.* [**SP**]
- Johnson, Rhodes, and Wildenbeest. "Platform Design when Sellers Use Pricing Algorithms." *Econometrica.* [**SP**]
- Leisten (2024). "Algorithmic Competition, with Humans." *Working Paper.*
- Miklós-Thal and Tucker (2019). "Collusion by Algorithm: Does Better Demand Prediction Facilitate Coordination Between Sellers?" *Management Science.* [**SP**]

6. Empirics

- Assad, Clark, Ershov, and Xu (2024). "Algorithmic Pricing and Competition: Empirical Evidence from the German Retail Gasoline Market." *Journal of Political Economy.* [**SP**]
- Musolff (2024). "Algorithmic Pricing, Price Wars, and Tacit Collusion: Evidence from E-Commerce." *Working Paper.* [**SP**]

7. Structural Econometrics for AI

- Cozzolino, Gualdani, Lomys, and Magnolfi (2025)." Robust Identification in Repeated Games: An Empirical Approach to Algorithmic Competition." *Working Paper.* [**C**]
- Hartline, Long, and Zhang (2024). "Regulation of Algorithmic Collusion." *Proceedings of the Symposium on Computer Science and Law.* [**SP**]

- Hartline, Wang, and Zhang (2025). "Regulation of Algorithmic Collusion, Refined: Testing Pessimistic Calibrated Regret." *Working Paper.* [**SP**]
- Lomys and Magnolfi (2024)." Estimation of Games under No Regret: Structural Econometrics for AI." *Working Paper.* [**C**]
- Nekipelov, Syrgkanis, and Tardos (2015). "Econometrics for Learning Agents." *Proceedings of the Sixteenth ACM Conference on Economics and Computation: EC 2015.* [**SP**]