

# ECON7153: EMPIRICAL GAME THEORY ANALYSIS

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National Taiwan University

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<b>Instructor</b>	Joonkyo Hong
<b>Office</b>	Rm 729, Social Science Building
<b>Contact</b>	jkhong@ntu.edu.tw
<b>Office Hours</b>	via Email
<b>Time</b>	Tuesday 2, 3
<b>Venue</b>	Rm 603, Social Science Building

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**Description** This course aims to introduce recent developments in estimating a discrete model of oligopolistic interactions using real-world data, primarily focusing on dynamic settings. We will begin by covering the required numerical methods for analyzing a game-theoretical model. Our initial focus will be on understanding non-linear equations, numerical optimization, and numerical integrations. Moving forward, we will briefly explore the static entry model, an exemplary textbook framework that serves as an introduction to empirical game-theoretical models. Before directly diving into the dynamics of interactions among long-lived firms in oligopolistic settings, we will touch on a single-agent dynamic discrete decision-making process as background. With a clear understanding of a single-agent dynamic discrete choice model, we will extend this model into a dynamic oligopoly framework and proceed to explore the methodologies of mapping this framework to real-world data.

**Textbook and Reference** There is no formal textbook for this course. The reading list will be posted on NTU COOL soon.

**Prerequisite** All students are expected to have basic understanding of graduate-level microeconomics and econometrics along with undergraduate-level game theory. Homework assignments will request numerical solutions to given games and the estimation of the models using provided datasets. I thus expect all students to have intermediate-level knowledge of MATLAB and STATA (or equivalent programs).

**Grading Policy** Four components determine your grade: Attendance, in-class presentation, Homework assignments and take-home exam. The relative weights are as follows:

Attendance .....	20%
In-class Presentation .....	20%
■ Two presentations, each accounting for 10%.	
Homework .....	30%
■ Two homework assignments, each accounting for 15%.	
Take-home Exam .....	30%

**In-class Presentation** Students are expected to present well-published papers from the reading list twice throughout this semester. Presentation times range from 20 to 30 minutes. Students can freely choose which paper they wish to present. The selections are first come, first-served basis. During their presentations, students should emphasize the following aspects of a paper:

1. Research question
2. Empirical approach
3. Key empirical findings
4. Contribution

## Course Outline

The schedule below is tentative. Any unexpected changes to the schedule will be announced in-class (as the course proceeds).

Digression - Nonlinear equation, Numerical optimization, Numerical Integration .....	
<i>Static Entry Game I</i> - Complete Information .....	
<i>Static Entry Game II</i> - Incomplete Information .....	
<b>Assignment 1</b> .....	
<i>Single-Agent Dynamic Discrete Choice Model I</i> - Ingredients .....	
<i>Single-Agent Dynamic Discrete Choice Model II</i> - Estimation Strategies .....	
<i>Single-Agent Dynamic Discrete Choice Model III</i> - Empirical Applications .....	
<b>Assignment 2</b> .....	
<i>Dynamic Discrete Games I</i> - Ingredients .....	
<i>Dynamic Discrete Games II</i> - Numerical Solutions .....	
<i>Dynamic Discrete Games III</i> - Estimation Strategies .....	
<i>Dynamic Discrete Games IV</i> - Empirical Applications .....	
<i>Dynamic Discrete Games V</i> - Remaining Issues in Literature (if time allowed) .....	
<b>Take-Home Exam</b> .....	TBD

## Reading List

*A General Reference for IO tools* .....

- Akerberg, Benkard, Berry, and Pakes (2007, Handbook of Econometrics), *Econometric Tools for Analyzing Market Outcomes*

*Handbooks for Each Unit* .....

- **Static Game of Entry:** Berry and Reiss (2007, Handbook of IO), *Empirical Models of Entry and Market Structure*
- **Single-agent DDC:** Arcidiacono and Ellickson (2011; Annual Review of Econ), *Practical Methods for Estimation of Dynamic Discrete Choice Models*
- **Dynamic Discrete Games:** Aguirregabiria, Collard-Wexler, and Ryan (2021; Handbook of IO), *Dynamic Games in Empirical Industrial Organization*

*Static Entry Game - Ground Works* .....

- \*\* Bresnahan and Reiss (1991, JPE), *Entry and Competition in Concentrated Markets*
- Berry (1992, ECMA), *Estimation of a Model of Entry in the Airline Industry*
- Tamer (2003, RESTUD), *Incomplete Simultaneous Discrete Response Model with Multiple Equilibria*
- \*\* Bajari, Hong, and Ryan (2010, ECMA), *Identification and Estimation of a Discrete Game of Complete Information*
- \*\* Ciliberto and Tamer (2009, ECMA), *Market Structure and Multiple Equilibria in Airline Markets*
- Bajari, Hong, Krainer, and Nekipelov (2010, JBES), *Estimating Static Models of Strategic Interactions*
- Pakes (2010, ECMA), *Alternative Models for Moment Inequalities*

*Static Entry Game - Recent Developments and Applications* .....

- † Berry and Waldfogel (1999, RAND), *Free Entry and Social Inefficiency in Radio Broadcasting*
- Mazzeo (2002, RAND), *Product Choice and Oligopoly Market Structure*
- Seim (2006, RAND), *An Empirical Model of Firm Entry with Endogenous Product-type*
- † Jia (2008, ECMA), *What Happens When Wal-Mart Comes to Town: An Empirical Analysis of the Discount Retailing Industry*
- Grieco (2014, RAND), *Discrete Games with Flexible Information Structures: An Application to Local Grocery Markets*
- Coşar, Grieco, and Tintelnot (2015, Restat), *Borders, Geography, and Oligopoly: Evidence from the Wind Turbine Industry*
- Sweeting (2006, RAND), *The Strategic Timing of Radio Commercials: An Empirical Analysis Using Multiple Equilibria*
- † Berry, Eizenberg, and Waldfogel (2016, RAND), *Optimal Product Variety in Radio Markets*
- Maruyama (2011, IER), *Socially Optimal Subsidies for Entry: The Case of Medicare Payments to HMOs*
- Wollmann (2018, AER), *Trucks without Bailouts: Equilibrium Product Characteristics for Commercial Vehicles*

*Single-Agent Dynamic Discrete Choice Model - Estimation* .....

- \*\* Rust (1987, ECMA), *Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurcher*
- \*\* Hotz and Miller (1993, RESTUD), *Conditional Choice Probabilities and the Estimation of Dynamic Models*
- Hotz, Miller, Sanders, and Smith (1994, RESTUD), *A Simulation Estimator for Dynamic Models of Discrete Choice*
- Aguirregabiria and Mira (2002, ECMA), *Swapping the nested fixed point algorithm: A class of estimators for discrete Markov decision models*
- \* Scott (2014, Working paper), *Dynamic Discrete Choice Estimation of Agricultural Land Use*
- Kalouptsi, Scott, and Souza-Rodrigues (2020, JoE), *Linear IV Regression Estimators for Structural Dynamic Discrete Choice Models*
- Su and Judd (2012, ECMA), *Constrained Optimization Approaches to Estimation of Structural Models*

*Single-Agent Dynamic Discrete Choice Model - Applications* .....

- Aw, Roberts, and Xu (2011, AER), *R&D Investment, Exporting, and Productivity Dynamics*
- Peters, Roberts, Vuong, and Fryges (2017, RAND), *Estimating dynamic R&D choice: an analysis of costs and long-run benefits*
- † De Groote and Verboven (2019, AER), *Subsidies and Time Discounting in New Technology Adoption: Evidence from Solar Photovoltaic Systems*
- Traiberman (2019, AER), *Occupations and Import Competition: Evidence from Denmark*
- Ransom (2022, Journal of Human Resources), *Labor Market Frictions and Moving Costs of the Employed and Unemployed*
- Khorunzhina (2013, JEDC), *Structural Estimation of Stock Market Participation Costs*
- † Diamond, McQuade, and Qian (2017, Working Paper), *The Effects of Rent Control Expansion on Tenants, Landlords, and Inequality: Evidence from San Francisco*  
<https://web.stanford.edu/~diamondr/DMQ01d.pdf>
- † Holmes (2011, ECMA), *The Diffusion of Wal-Mart and Economies of Density*
- † Dickstein and Morales (2018, QJE), *What do Exporters Know?*

*Dynamic Discrete Games - Computation* .....

- \*\* Pakes and McGuire (1994, RAND), *Computing Markov-perfect Nash equilibria: Numerical implications of a dynamic differentiated product model*
- Ericson and Pakes (1995, RESTUD), *Markov-perfect industry dynamics: A framework for empirical work*
- Doraszelski and Satterthwaite (2010, RAND), *Computable Markov-Perfect Industry Dynamics*
- Weintraub, Benkard, and Van Roy (2008, ECMA), *Markov Perfect Industry Dynamics With Many Firms*
- Benkard, Jeziorski, and Weintraub (2015, RAND), *Oblivious equilibrium for concentrated industries*

*Dynamic Discrete Games - Estimation* .....

- \*\* Aguirregabiria and Mira (2007, ECMA), *Sequential Estimation of Dynamic Discrete Games*
- \*\* Bajari, Benkard, and Levin (2007, ECMA), *Estimating Dynamic Models of Imperfect Competition*
- Arcidiacono and Miller (2011, ECMA), *Conditional Choice Probability Estimation of Dynamic Discrete Choice Models with Unobserved Heterogeneity*
- Pakes, A., M. Ostrovsky, and S. Berry (2007, RAND), *Simple estimators for the parameters of discrete dynamic games (with entry/exit examples)*
- Pesendorfer and Schmidt-Dengler (2008, RESTUD), *Asymptotic least squares estimators for dynamic games*

*Dynamic Discrete Games of Entry-Exit* .....

- Benkard (2004, RESTUD), *A Dynamic Analysis of the Market for Wide-Bodied Commercial Aircraft*
- † Ryan (2012, ECMA), *The Costs of Environmental Regulation in a Concentrated Industry*
- Dunne, Klimek, Roberts, and Xu (2013, RAND), *Entry, exit, and the determinants of market structure*
- † Collard-Wexler (2013, ECMA), *Demand Fluctuations in the Ready-Mix Concrete Industry*
- † Takahashi (2015, AER), *Estimating a War of Attrition: The Case of the US Movie Theater Industry*
- Lin (2015, IER), *Quality choice and market structure: a dynamic analysis of nursing home oligopolies*
- Suzuki (2013, IER), *Land Use Regulation as a Barrier to Entry: Evidence from the Texas Lodging Industry*

*Dynamic Discrete Games of Innovation* .....

- † Goettler and Gordon (2011, JPE), *Does AMD Spur Intel to Innovate More?*
- † Igami (2017, JPE), *Estimating the Innovator's Dilemma: Structural Analysis of Creative Destruction in the Hard Disk Drive Industry, 1981–1998*
- Igami and Uetake (2020, RESTUD), *Mergers, Innovation, and Entry-Exit Dynamics: Consolidation of the Hard Disk Drive Industry, 1996–2016*
- Hashmi and Biesebroeck (2016, Restat), *The Relationship between Market Structure and Innovation in Industry Equilibrium: A Case Study of the Global Automobile Industry*

*Other Applications of Dynamic Games* .....

- Kellogg (2014, AER), *The Effect of Uncertainty on Investment: Evidence from Texas Oil Drilling*
- Jeon (2022, RAND), *Learning and Investment under Demand Uncertainty in Container Shipping*
- Caoui (2023, RESTUD), *Estimating the Costs of Standardization: Evidence from the Movie Industry*
- † Hollenbeck, Osborne, and Caoui (2023, Working paper), *The Impact of Dollar Store Expansion on Local Market Structure and Food Access*
- Kalouptsidi (2014, AER), *Time to Build and Fluctuations in Bulk Shipping*
- † Kalouptsidi (2018, AER), *Detection and Impact of Industrial Subsidies: The Case of Chinese Shipbuilding*
- † Granja (2022, Working paper), *Regulation and Service Provision in Dynamic Oligopoly: Evidence from Mobile Telecommunications*

*Unpleasant Feature of Dynamic Models of Discrete Actions: Payoff Normalization* .....

- Aguirregabiria and Suzuki (2014, QME), *Identification and Counterfactuals in Dynamic Models of Market Entry and Exit*
- Kalouptsidi, Scott, and Souza-Rodrigues (2020, QE), *Identification of Counterfactuals in Dynamic Discrete Choice Model*
- Kalouptsidi, Scott, and Souza-Rodrigues (2017, IJIO), *On the Non-Identification of Counterfactuals in Dynamic Discrete Games*