COMSCI/ECON 206

Computational Microeconomics

Autumn 2025

昆山杜克大学
DUKE KUNSHAN UNIVERSITY

Dates: August 18, 2025, – October 10, 2025
Meeting time: MoWe 2:45 PM - 5:15 PM
Location: IB 2025
Course format: Seminar (+ Field Trip)

Feedback for COMSCI/ECON 206 — Problem Set 1

Deployment of a Strategic Game: An Interdisciplinary Study

Dear Boyan,

Thank you for your work on the deployment of a budgeted second-price auction. Your theoretical framing and motivation are strong, especially in articulating how budget constraints affect dynamic bidding behavior in repeated auctions. The discussion on subgame perfect equilibrium under intertemporal constraints is insightful.

However, the submission currently lacks several critical components necessary for full reproducibility and clarity. Please see below for detailed suggestions.

🔷 Comments for Improvement

1. **Google Colab and GTE Code Output Missing**
   - The **Google Colab and Game Theory Explorer** implementations are mentioned but **not shown**. No figures are actually rendered or explained, and placeholder image paths are left without content (e.g., "`figures/price_path.png`").
   - Moreover, the **equilibrium analysis is not exemplified numerically**. You state that equilibrium involves threshold strategies, but the code to demonstrate different cases—such as:
     - Both players bidding their true values;
     - One player overbidding;
     - One player passing—is **not presented or discussed**.
   - **Suggestion**: Include at least three illustrative scenarios (e.g., (80, 60), (90, 100), (70, 70)) and simulate the bids and outcomes in Colab or Python. Show the thresholds visually using the actual plotted figures.
2. **Missing oTree Citation and Adaptation Explanation**
   - The **original oTree platform is not cited**, and you do not specify how the dynamic auction app was adapted. For a behavioral experiment that modifies the base second-price auction, this is essential.

- **Please cite**:
  - Chen, D. L., Schonger, M., & Wickens, C. (2016). *oTree—An open-source platform for laboratory, online, and field experiments*. *Journal of Behavioral and Experimental Finance*, 9, 88–97.
- Clarify:
  - What you changed in the app (e.g., round structure, budget updates, instructions).
  - What behavioral theory those changes were meant to test.

3. **Writing and Presentation Issues**
   - **Figures are not embedded**, labeled, or mentioned in the body of the text. Placeholder paths (e.g., `figures/budget_trajectories.png`) appear with no actual images or descriptive analysis.
   - The **PDF contains no reference list**, even though several academic sources are cited inline (e.g., SpirakisSlides, GhoshLiu2016). This breaks academic conventions.
   - Suggestion:
     - Add all cited works into a formal **References** section.
     - Embed and reference each figure with descriptive captions.
     - Describe clearly what the figure shows, and how it supports your argument.
4. **Additional Suggestions**
   - Include a top-level summary in the **README** on GitHub.
   - Break down results per subdiscipline (economist, computational, behavioral).
   - Consider summarizing the AI vs. human behavior comparison in a **table or chart**.

Final Grades Breakdown (20 Points Total)

Criterion	Max	Earned
Code	5	4.0
Explanations for Code	2.5	2.0
Writing Analysis	2.5	2.0
Thesis/Focus (Essay)	2	2
Organization (Essay)	3	2.5
Reasoning (Essay)	3	2.0
Use of Sources/Documentation	2	1.5
Total	**20**	**16.0**

You've built a strong conceptual foundation for the dynamic auction model. With the addition of actual figures, code output, and detailed citations, this project could become a compelling contribution to interdisciplinary mechanism design. Looking forward to your revisions!

COMSCI/ECON 206 — Problem Set 1

Deployment of a Strategic Game: An Interdisciplinary Study

Due: Sunday Sep. 14, 11:00 P.M. (BJT) • **Weight:** 20%

0) Purpose & Learning Outcomes

This problem set scaffolds your skills across economics, computation, and behavioral science using one strategic interaction. You will: (i) formalize and analyze equilibria, (ii) compute and visualize solutions with standard tools, and (iii) compare theoretical predictions with human and LLM behavior.

1) Choose Your Game

Select any strategic game you feel comfortable analyzing end-to-end.

For this assignment, please ensure that the **game you choose is different from the Prisoner's Dilemma and Battle of the Sexes** that we demonstrated in class.

Additional Note for Deployment

For the convenience of deployment, you may adapt an existing demo available on **oTree**. However, you must:

1. **Refer to the original source** of the demo you adapted.
2. **Revise the game** to suit your project. This includes modifying aspects such as:
    - The **number of players**.
    - The **payoff structures**.
    - Any other key parameters that affect gameplay and analysis.
3. **Describe the changes you made and explain why** these revisions were necessary (e.g., to test a specific hypothesis, fit within team size, or highlight a particular strategic dynamic).
4. Ensure that **each member of the team adapts the demo in a different way**. For example, one member could adjust the number of players, another could restructure the payoff matrix, and another could modify timing or matching rules.

2) Deliverables

A. One PDF (recommended via LaTeX/Overleaf) containing Parts 1–3 with figures, screenshots, and references, and Data/Code Availability statement with your GitHub repo URL
B. A GitHub repository organized as in Section 5, containing all supporting assets.

Grading reference. Evaluation follows the **General Requirements & Rubric** in the attached document. Please review it carefully and ensure your submission satisfies those standards.

3) The Three Parts

Part 1 — Economist (theory & welfare; 30 points)

1. Equilibrium concept: Identify an appropriate concept (e.g., Nash, mixed, SPNE, Bayes–Nash, correlated). Paraphrase the definition and an existence theorem (plus brief proof idea) in your own words with rigorous notation (strategy sets, payoff functions, assumptions like compactness/continuity or the logic of backward induction). Cite page/section numbers in textbooks and/or original papers.

2. Analytical solution: Characterize equilibria; discuss efficiency (Pareto, utilitarian, etc.) and fairness (e.g., equity/inequality, envy-freeness, proportionality as appropriate).

3. Interpretation: Discuss realism, multiplicity, and refinements; connect to bounded rationality (Week 1) and computational tractability (Week 2).

Part 2 — Computational Scientist (coding & tools; 40 points)

2a) Google Colab (normal form + computation):
Present the normal-form payoff matrices, compute equilibria using NashPy and/or QuantEcon, and interpret the outputs. Include screenshots in your PDF of: (i) the displayed payoff matrices, (ii) solver outputs, (iii) your brief interpretation.

2b) Game Theory Explorer (extensive form + SPNE):
Build an extensive-form version in GTE, label players/histories/information sets, solve via the SPNE tool, and explain how SPNE relates to Part-1 and to the simultaneous normal form. Include screenshots of the tree and solution panel.

Part 3 — Behavioral Scientist (experiment & AI comparison; 30 points)

3a) oTree deployment:
Provide an oTree app zip (ready to run), screenshots of instructions/decision/results pages, and a short README with install/run steps and session config. Run a brief session with two classmates (**use your pre-assigned group and the meeting time you committed to in Monday's class):** record choices, payoffs, and 1–2 post-play interview questions per participant.

3b) LLM "ChatBot" session:
Play the same game with at least one LLM. Document exact prompts and settings; record stated reasoning and choices (one-shot or repeated). Note whether framing or payoff visibility changes behavior.

3c) Comparative analysis & theory building:
Compare (i) equilibrium predictions, (ii) human session, and (iii) LLM session.

Use behavioral/experimental economics and AI/LLM-games literature to propose a plausible explanation for any discrepancies and outline a potential refinement/new solution concept to better predict human or AI choices.

5) GitHub Repository — Required Structure

<Name of the Game>:<An Interdisciplinary Study>/
• README.md — title, abstract, task summary, reproduction steps
• economist/ — README with citations to textbook pages/papers (page/section refs); refs/ for PDFs/BibTeX as permitted
• computational_scientist/ — notebook.ipynb (Colab-export); README with how-to-run and GTE screenshots (with captions); optional gte/ exports
• behavioral_scientist/ — otree_app.zip; screenshots/ (game pages & session results); llm/ (prompts.txt, transcript.md, settings.json); README with deployment steps, session config, brief ethics note

Software citation requirements (must appear in your bibliography):

Each open-source tool you use must be formally cited exactly as its documentation specifies. For example:

• Thomas J. Sargent and John Stachurski (2021). Quantitative Economics (Python), Version 0.5.1.
• Vincent Knight (2021). Nashpy: A Python library for the computation of equilibria of 2-player strategic games, Version 0.0.28.
• Rahul Savani and Bernhard von Stengel (2015). Game Theory Explorer – Software for the Applied Game Theorist. *Computational Management Science* 12, 5–33.

Supplementary Materials:

QuantEcon/NashPy Demo:
https://colab.research.google.com/drive/1xDTHC7VZQTu3ge_f6Bf7oiHN1mLEZ75q?usp=sharing

The Definition/Existence of Nash Equilibrium in Latex:

https://www.overleaf.com/read/mysvwhtgbrdc#5cb99c

NashPy: https://nashpy.readthedocs.io/en/stable/

QuantEcon: https://quantecon.org/quantecon-py/

Game Theory Explorer: http://www.gametheoryexplorer.org/

Textbook I:
Title: Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations
Authors:
Yoav Shoham, Stanford University, California, Kevin Leyton-Brown, University of British Columbia, Vancouver
ISBN-13: 978-0521899437
ISBN-10: 0521899435
Publisher: Cambridge University Press
Online Access：{Download Free Electronic Version; Cambridge University Press Website}

Textbook II:
Title: A Course in Game Theory
Authors: Prof. Ariel Rubinstein and M. Osborne.
ISBN-10: 0262650401

ISBN-13: 978-0262650403
Online Access: {Ariel Rubinstein Website}

Textbook III:
Title: Twenty Lectures on Algorithmic Game Theory
Authors: Tim Roughgarden, Stanford University, California
Online ISBN: 9781316779309
DOI: https://doi.org/10.1017/CBO9781316779309
Publisher: Cambridge University Press
Online Access：{Cambridge University Press Website}