Three Papers on Strategic Decision Making In Digitally Mediated Markets

Dissertation Defense

Anna V. Osepayshvili

Committee:
Prof. Jeffrey K. MacKie-Mason (Chair)
Prof. Yan Chen
Assistant Prof. Rahul Sami
Prof. Michael P. Wellman

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Chapter 1
Bidding Strategies for Simultaneous Ascending Auctions

Joint work with Michael P. Wellman, Jeffrey K. MacKie-Mason, and Daniel Reeves

SAA Game: Example

Number of goods	2 stamps: A and B
Number of bidders	2 agents: 1 and 2
Joint distribution of values	F
SAA mechanism rules	concurrent auctions
	multiple rounds
	highest bid wins

RQ & motivation

Method

Analysis

Results & contribution

Research Question

How should one bid in SAAs when the goods are complements or substitutes?

Motivation

Example: Exposure Problem

(If agent has complementary preferences)

	Value for stamp A	Value for stamp B	Value for the whole package
Agent 1	20	20	20
Agent 2	0	0	30

RQ & motivation

Method

Analysis

Results & contribution

Motivation

Example: Own Price Effect

(If agent has substitutable preferences)

	Value for stamp A	Value for stamp B	Value for the whole package
Agent 1	20	20	20
Agent 2	21	21	42

RQ &
motivation

Method

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Results &
contribution

Common approach to strategy selection:

Find equilibrium strategies

Empirical Game-Theoretic Methodology:

How do we find equilibrium strategies in complex SAAs?

Analysis

All strategy families belong to class of

perceived-price bidders

Price-prediction methods

- Myopic prediction
- Based on empirical data from other (simulated) auctions
- Based on Walrasian equilibrium prices
- Self-confirming prices

RQ & motivation

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Results & contribution

Analysis & Results

	Complements (exposure problem)	**Substitutes (own price effects)**
Largest empirical SAA game	5 goods, 5 agents	5 goods, 5 agents
	"uniform" preference distrubution	"uniform" marginal values
	53 strategies	51 strategies
Hypothesized winner	Distribution price predictor w. *self-confirming prices*	Own-effect price predictor w. *self-confirming own-effect prices*
Winner	*As hypothesized*	Demand-reduction strategy

Contributions

If goods are complements

Self-confirming distribution predictor

If goods are substitutes

Demand-reduction strategy

Chapter 2
Bundling Information Goods: A Study of Competing Firms Facing Heterogeneous Consumers

Joint work with Jeffrey K. MacKie-Mason and Scott A. Fay

Motivation

Why bundling?

- High 1st-copy costs, low reproduction costs
- Digital technology exaggerates

Why competing firms?

- Monopoly is well studied, competition is not

Why heterogeneous tastes?

- Ex ante homogeneous tastes well studied
- My model is specific to information goods
- My model is appropriate to study mixed bundling

Firms & Consumers

- 2 firms, each owns a collection of items
- Subadditive preferences over items
- Reproduction and distribution costs are zero
- Consumers buy at most one copy of an item
- Two-dimensional heterogeneity of tastes
  - w - value of favorite item
  - k - percentage of items valued positively
- 3 bundling strategies
  - Individual items (pure unbundling, PU)
  - Pure bundling (PB)
  - Mixed bundling (MB)
- Simultaneously choose scheme and prices

RQ & motivation

Method

Analysis

Results & contribution

Research Questions

- Can simple MB effectively sort consumers under competition?

- How do equilibrium profits compare to those when firms are restricted to PB or PU? How do PB and PU compare to each other?

- How big is the difference?

- How much surplus do bundling firms extract under competition? How does it compare to monopoly profit?

- Market efficiency? Relative to monopoly?

RQ & motivation

Method

Analysis

Results & contribution

Method

Empirical Game Analysis

RQ & motivation

Method

Analysis

Results & contribution

Empirical Game Analysis

9 environments

- 3 distributions of consumer preferences
  - fixed ***w***,
    k exponentially decreases with number items that a consumer values positively
  - fixed ***k***, uniformly distributed ***w***
  - uniform ***w***, exponential ***k***
- For each, 3 market models:
  - symmetric duopoly
  - non-symmetric duopoly
  - monopoly

Monopoly Results

- Whether MB can effectively sort consumers, depends on consumer preference distribution
- PB can be dominated by PU

Duopoly Results

- Each scheme largely works in the same way as under monopoly to extract consumer surplus
- MB intensifies price competition; can result in lower equilibrium profits than PU or PB

Duopoly vs. Monopoly

- Market efficiency is greater by up to 16%
- Welfare shifts toward consumers by up to 22%
- Largest drop in profits is by 21%

Contributions

- Extended analysis of bundling schemes to a competitive setting
- .. for a model of consumer preferences specific to information goods

Particularly interesting:

- Under what preference distributions
  - MB works as price-discrimination tool
  - Pure schemes yield higher profits in equilibrium
- Even under monopoly PU can dominate PB

Chapter 3
Learning Bayesian Nash Equilibrium: An Experimental Study

Under supervision of Yan Chen and Jeffrey K. MacKie-Mason

RQ & motivation

Method

Hypotheses

Results & contribution

Research Questions

In games of incomplete information,

- Do people learn to play Bayesian Nash equilibrium (BNE)?

- What factors affect learning of BNE?

- How do the answers differ when the information assumption is not satisfied?

Motivation

Who cares?

- Practical applications of game theory

Why BNE?

- Main solution concept in games of incomplete information

Why is empirical verification important?

- "Problematic" theoretical assumptions:
  - common knowledge of type distribution
  - self-interested rational behavior

RQ & motivation

Method

Hypotheses

Results & contribution

Method: Human-Subject Laboratory Experiment

Domain: Family of Cournot Duopoly Games

	Bayesian Information			Low Information	
	Non-Potential	Potential		Non-Potential	Potential
Non-Supermodular	3 sessions	3 sessions		3 sessions	3 sessions
Supermodular	3 sessions	--------		3 sessions	--------

RQ & motivation

Method

Hypotheses

Results & contribution

Convergence Measure

Distance from equilibrium payoff

= |Actual payoff - Equilibrium payoff|

Hypotheses

Convergence Level & Improvement Rate

Environment		**Counterpart Environment**
Bayesian info	better/ faster than	low info
potenial	better/ faster than	non-potential
supermodular	different from	non-supermodular

Results

Average Convergence Level

Bayesian info	better than	low info
potenial	better than	non-potential
supermodular	better than	non-supermodular
supermodularity interacts with information: effect is drastically reduced under Bayesian info		

Rate of Convergence Improvement

Bayesian info	slower than	low info
potenial	faster than	non-potential
supermodular	same	non-supermodular

Contributions

- What factors affect learning of BNE? How does the answer differ when the info assumption is not satisfied?

potential, supermodularity, info; possible losses, incentives to collude

Particularly interesting:

interaction b/w supermodularity and info appears to be due to different types of irrationality that prevail

- Do people learn to play BNE?

Average distance in last 10 rounds is 9--18% of average payoff range

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Thank you.