



Brown Course Registration

Market dynamics, strategy-proofness
and considerations for alternatives

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Our Model for the Market

- Students a_1, \dots, a_n have preferences over bundles of courses b_1, \dots, b_m
- Preferences can change over time
- $b_i = \{c_v, c_w, c_x, c_y, c_z\}$
- Students can add/drop classes when $t \in [0, s]$
 - Assumption: No transaction time
- $p_t(c_j)$ = probability that c_j will be available at time t
 - $p_t(c_j) = 1$ for uncapped courses
 - $p_t(c_j) \in (0, 1)$ for capped courses
- $p_t(b_i) = p_t(c_v) \dots p_t(c_z)$
- $U(b_i) \geq 0$ (due to drops)
- $EU(b_i) > 0 \quad \forall i$ (uncertainty)



Problem:

The market is not strategy-proof

Students do not have an incentive to state their true preferences until the end of the add/drop period (aka $t=s$)

Proof

- When $t = s$

- Students will choose bundle b_i among all available bundles such that

$$\max U(b_i)$$

- When $t \in [0, s)$

- Students want to maximize their chance to obtain a high utility bundle, so they pick a bundle b_i such that

$$\max [(1 - p_s(c_v)) \dots (1 - p_s(c_z)) EU_t(b_i)]$$

- Assumption: Risk neutrality
- If $p_s(c_j) = 1$, then the equation becomes 0
- Thus, the student will choose a bundle formed only by capped courses.



Why is this a problem?

- Students do not take certain capped classes because they were initially overbooked
- Students cannot accurately estimate their chances to get into a capped class
- University uses preregistration to assign classrooms and TAs to classes based on size – distorted by strategic playing
- Professors cannot estimate the future size of their class, which can interfere with their planning

Data Analysis

- We want to prove 2 things:
 1. Students use this strategy of registering for more capped courses than they plan to take
 2. As students have more experience with system, they use this strategy more

Proportion of registrations that are for capped courses

	End of Pre-Reg.	End of Reg.
2007		
2008		
2009		
2010		
2011		

- If a greater proportion of course registrations are for capped courses in pre-reg. than final registration, this supports the conclusion that students use this strategy
- If this gap widens over time, we can infer that students are learning to game Banner as they gain experience with the system



Experimental Game

- Students participate in a game with A-assets and B-assets, representing capped and uncapped courses
- A- and B-assets each have two possible values. Participant is shown a set of two possible values for each asset:
 - $A1 = 3$ or 4
 - $A2 = 3$ or 5
 - $A3 = 0$ or 9
 - $B1 = 3$ or 4
 - etc

Experimental Game, continued

Period 1

- Participant is shown 2 possible values for each asset, and chooses a portfolio of 3

Period 2

- True values of each asset are revealed

Period 3

- Participant can drop any assets
- Participant can add any B-assets to their portfolio

The participant receives a cash payout at the end according to the value of the assets in his or her portfolio

Participants will learn over time to always choose A-assets in Period 1, as B-assets can always be added in Period 3



Literature

- **Budish and Cantillon**, The Multi-unit Assignment Problem: Theory and Evidence from Course Registration at Harvard, *American Economic Review* (forthcoming)
 - (<http://faculty.chicagobooth.edu/eric.budish/research/budish-cantillon-course-alloc-harvard-May2011.pdf>)
- **Featherstone**, Rank Efficiency: Investigating a Widespread Ordinal Welfare Criterion
 - (<http://www.stanford.edu/~cfeather/Featherstone-JobMarketPaper10.pdf>)



Literature – Featherstone, 2011

- “A deterministic assignment is ex post efficient if and only if it can be generated by serial dictatorship with indifferencees relative to some ordering π ”
- Ex post (or Pareto) efficiency if and only if the mechanism can be represented as a lottery over deterministic agents



More on Pareto Efficiency

- A process in which agents can change their registrations after everyone has registered cannot fit this definition of serial dictatorship
- By allowing students to change registrations, Brown does not allow the mechanism to be Pareto efficient
- Brown chooses to give up Pareto efficiency in order to give more weight to students' changing preferences



Literature – Budish and Cantillon, 2011

- Course allocation at Harvard Business School
- Comparing manipulable mechanisms to random serial dictatorship
 - Fairness-Efficiency tradeoff? NO
 - Some manipulable mechanisms are more ex-ante efficient than random serial dictatorship, both in terms of individual welfare (if risk neutral or averse) and social welfare



Considerations for Alternatives

- Dean Lassonde and Registrar Fitzgerald: Departments have ultimate say on how students should be selected for courses
- Any alternative must not threaten department choice
- For example: this poses a problem with instituting a waitlist for courses
- However, it wouldn't be a problem with creating an optional waitlist system that worked under a mechanism preferred by the department
- Would not be able to implement one overarching mechanism for all courses because that would challenge “department supremacy”
- Would have to build “optional add-ons” to current mechanisms.



Operational Constraints

- Must be easily operated by professors, department administrators, and students

Business Constraints

- A company like Banner has a small market for advanced course registration mechanisms (only Brown and institutions with similar curricular philosophies)
- Costs of developing them are very high



Add-Ons

- Fitzgerald: Banner has built-on features on top of Banner's code (eg – Brown Course Scheduler). If Brown changes their code, Banner cannot be upgraded
- This leaves Brown somewhat limited in terms of what kind of “optional add-ons” the could make to Banner (or any of its competitors)
- Add-ons should not interfere with Banner's code



Conclusion

- Market for course registration is not strategy-proof
- This theoretical prediction can be tested:
 - Real data analysis
 - Experimental game
- There are several constraints on the alternatives to the current system
- Questions? Comments?