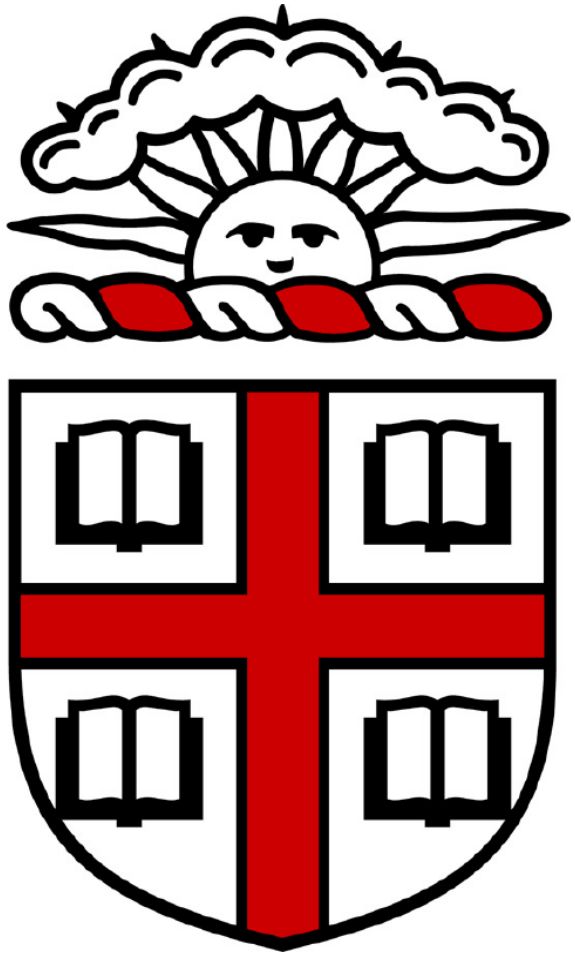
Brown Course Registration



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The Problem

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- Little incentive for individuals to register for the classes they are most likely to take next semester. Instead, the incentive is for students to register for classes that are capped at a low number of individuals.
- Some of our fellow classmates were unable to obtain a spot in a class that they strictly prefer to all of their current courses, despite the fact that after shopping period was completed there remained multiple openings.
- Current system creates a perverse incentive for students to sell their seats in classes that are in high demand and have a limited enrollment.
- This secondary market is unfair towards students who are individually trying to register for the course and are extremely interested in the course (apart from being against the Academic Code).
- Students can rendezvous with their peers to swap classes at odd hours

The Basic model

THE BASIC MODEL

- During preregistration each student is allowed to select up to five classes.
- Students have a set of preferences over the classes such that:

$$c_1 \succ_s c_2 \iff u_s(c_1) > u_s(c_2)$$

$$\emptyset \succ_s c_i \iff u_s(c_i) < 0$$

- The student's utility is the sum of their utility for each individual class:

$$U_s = \sum_{i \in S_i} u_s(c_i)$$

$S_i \in C$ is the student's selection of courses from C, the set of all courses.

Utility decays over time

- During registration students can add and drop classes.
- Adding a class after it has started reduces the utility the student receives from choosing it.

$$U_s = \sum_{i \in S_i} u_s(c_i) f(t_i)$$

- Where t_i is the number of hours of the class that have already been given before the student registers. $f(t_i)$ is a decreasing function and $f(0) = 1$.
  - Ex.

$$f(t_i) = 1 - \frac{t_i}{4}$$

*Note: After a certain amount of time has passed the utility the student gains by adding the class will be negative.

Buying and selling seats

- Students can also buy and sell their preregistration spots.
- The seller receives a payment ρ and the buyer acts as if they were able to preregister for that class (adding it to their other five).
- To reflect this exchange the utility function behaves in the following manner:

$$U_s = \sum_{i \in S_i \setminus j,k} u_s(c_i) f(t_i) + \rho_j + \rho_k$$

- In our model it is mandatory for students to preregister for 3 classes, so a maximum of 2 spots may be sold.

Example

- Alison (senior), Dylan (junior), and Mike (junior) are 3 students.
- Each student can register for 5 out of the 6 available classes.

D: $c_2 \succ_d c_4 \succ_d c_5 \succ_d c_1 \succ_d c_3 \succ_d \emptyset \succ_d c_6$

A: $c_1 \succ_a c_2 \succ_a c_3 \succ_a c_4 \succ_a \emptyset \succ_a c_5 \succ_a c_6$

M: $c_5 \succ_m c_1 \succ_m c_2 \succ_m c_3 \succ_m c_4 \succ_m \emptyset \succ_m c_6$

- Class 5 fills up before juniors are allowed to preregister. Because Dylan bought a seat in the class he is preregistered for it, but Mike is not.

Example (cont'd)

- Each student has the following utility function:

$$U_d = u_d(c_2)f_d(t_2) + u_d(c_4)f_d(t_4) + u_d(c_1)f_d(t_1) + u_d(c_3)f_d(t_3) + u_d(c_5)f_d(t_5)$$

$$U_a = u_a(c_1)f_a(t_1) + u_a(c_2)f_a(t_2) + u_a(c_3)f_a(t_3) + u_b(c_4)f_b(t_4) + \rho_5$$

$$U_m = u_m(c_1)f_m(t_1) + u_m(c_2)f_m(t_2) + u_m(c_3)f_m(t_3) + u_m(c_4)f_m(t_4)$$

- During the registration period Dylan's preferences change:

$$c_2 \succ_d c_4 \succ_d c_1 \succ_d c_3 \succ_d \emptyset \succ_d c_5 \succ_d c_6$$

- Dylan now would rather not take a class than take c_5 and drops it.
- Mike can now take Dylan's spot in the class, however because time has passed since the class begun:

$$u_m(c_5)f_m(t_5) < 0$$

- It is now too costly for Mike to register for c_5 and he will stay with his original four classes.

SOLUTION 1- REGISTER FOR WAITLIST

IMPLEMENTING THE MODEL

The waitlist

- Students MUST sign up for minimum of 3 classes
  - 3 classes are needed to be a "full-time" student
- Can be on waitlist for maximum of 2 classes because they account for the 5 spots
- Automatically know spot on waitlist when register on Banner
- Can't trade spots on waitlist
  - when spot is dropped by student registered for class, first person on waitlist automatically gets that spot
- When signing up for class that has a waitlist, the student is placed at bottom of the waitlist
- The only way to move up waitlist is for students ahead of you to drop the class

Waitlist System- Modeling Utility

- Still decays over time, but on waitlist there is no decay
- utility from classes that a student is waitlisted for, depends on student's spot on waitlist

- w_j is the student's spot on waitlist
- τ_c is the total size of the class

$$g(w_j, \tau_{cj}) = 1 - \frac{w_j}{\tau_{cj}}$$

- as higher on waitlist, value of g decreases

$$U_s = \Sigma u_s(c_i) f(t_i) + u_s(c_j) f(t_j) g(\omega_j, \tau_{cj}) + u_s(c_k) f(t_k) g(\omega_k, \tau_{ck})$$

Revisit Example With The Waitlist

- Using the same preferences as the earlier example:

$$\begin{aligned} \text{A}: &\quad c_1 > c_2 > c_3 > c_4 > \phi > c_5 > c_6 \\ \text{D}: &\quad c_2 > c_4 > c_5 > c_1 > c_3 > \phi > c_6 \\ \text{M}: &\quad c_5 > c_1 > c_2 > c_3 > c_4 > \phi > c_6 \end{aligned}$$

- Class 5 fills up before the juniors, Dylan & Mike, can register
- Dylan and Mike are now placed on the waitlist and their utility functions are:

$$\mu_a = \mu_a(c_1)f(t_1) + \mu_a(c_2)f(t_2) + \mu_a(c_3)f(t_3) + \mu_a(c_4)f(t_4)$$

$$\mu_d = \mu_d(c_2)f(t_2) + \mu_d(c_4)f(t_4) + \mu_d(c_1)f(t_1) + \mu_d(c_3)f(t_3) + \boxed{\mu_d(c_5)g(\omega_d(c_5), \tau_d(c_5))f(t_5)}$$

$$\mu_m = \mu_m(c_1)f(t_1) + \mu_m(c_2)f(t_2) + \mu_m(c_3)f(t_3) + \mu_m(c_4)f(t_4) + \boxed{\mu_m(c_5)g(\omega_m(c_5), \tau_m(c_5))f(t_5)}$$

Changing preferences & The Waitlist

- With the new preferences, D will drop off waitlist for c_5
- M will move up on the waitlist for c_5
- A is not affected by the change is D's preferences

- The new utility functions are:

$$\mu_d = \mu_d(c_2) + \mu_d(c_4) + \mu_d(c_1) + \mu_d(c_3)$$

$$\mu_a = \mu_a(c_1) + \mu_a(c_2) + \mu_a(c_3) + \mu_a(c_4)$$

$$\mu_m = \mu_m(c_1) + \mu_a(c_2) + \mu_a(c_3) + \mu_a(c_4) + \mu_m(c_5)g(\omega_m(c_5), \tau_m(c_5))f(t_5)$$

- $\omega_m(c_5)$ is lower now, so $g(\omega_m(c_5), \tau_m(c_5))$ is higher
- M is now better off
  - Compared to when change occurs without waitlist
  - Same result as without trading

WAITLIST- WHAT DOES IT SOLVE?

- Removes payment for seats and repugnance associated with this behavior
  - no longer incentive for A to sign up for c_5 for D
- M has just as much of a chance as D to get into c_5
- However, the waitlist doesn't take into account the fact that some student's prefer to be in the class more than other students

SOLUTION 2-
CREATING A THICK MARKET

Market Thickness

- Once an already registered seat is dropped during registration period, one cannot register for it till the following day at 8 AM.
- This will prevent students from maliciously scheming amongst themselves and swap classes by meeting clandestinely
- Will also lower the amount of time students spend planning with friends
- By creating a thicker market, everybody has a fair shot at getting the class in the morning of the next day

Market Thickness

- We also understand, however, that this way students who are extremely interested in the class get no higher chance of getting the class but it still goes by our definition of "fair" i.e. not allow students (even graduate students) game the system
- Introduces a random element - internet delay, etc..
- There is already an element of randomness when it comes to students checking up at random times when the seat is free.

Experimental Design

Experimental Design

- Survey students to determine if there is an existing problem, and to see if students have ever colluded in the past.
- See if anyone has given up on trying to get into a class before the end of registration, and was disappointed about not getting into the class.
- Given administration permission one can analyze banner data and see how many students drop and add a class within a small period of time
- This data will be compared to the average and we will determine the probability of a class being dropped and added within a small timeframe.
- Run a fake pre-registration on students with a wait list system is implemented

Conclusion

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- There is an obvious problem with the system but we need to see if implementing any of our solutions i.e. creating a thick market or a waitlist, will do more harm than good.
- For example, it could lead to crashing Banner at that particular time everyday in the case of a thick market.
- For example, students might miss out on getting into another class i.e. be forever stuck on the waitlist. This way they will be forced to take a class lower on their preference list.
- We welcome comments, suggestions to the model or any other way that we can improve upon our work.