Assignment in the SFUSD

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Who are we?

As a team, our members have helped redesign allocation methods for:

- Boston Public Schools
- NYC High Schools
- Medical residency and fellowship matches
- Market for new economics professors
- New England Program for Kidney Exchange

Papers pertaining to school choice

Abdulkadiroglu, Atila, and Tayfun Sönmez, "School Choice: A Mechanism Design Approach", *American Economic Review,* 93-3: 729-747, June 2003.

Abdulkadiroglu, Atila , Parag A. Pathak, and Alvin E. Roth, "The New York City High School Match," *American Economic Review*, Papers and Proceedings, 95,2, May, 2005, 364-367.

Abdulkadiroglu, Atila, Parag A. Pathak, Alvin E. Roth, and Tayfun Sönmez, "Changing the Boston School Choice Mechanism," January, 2006.

Abdulkadiroglu, Atila , Parag A. Pathak, and Alvin E. Roth, "Strategy-proofness versus Efficiency in Matching with Indifferences: Redesigning the NYC High School Match," November, 2008, *American Economic Review*, forthcoming.

Diverse Schools

We can help SFUSD to create diverse and quality schools through several channels:

- Designing a flexible assignment system
- Monitoring (and adjusting) the assignment system over time
- Looking beyond assignment
  - How we can increase participation?
  - How we can change current demand patterns?

Outline of the talk

- **Design of the new assignment system**
  - Proposals for:
    - Elementary school **(ES)**
    - Middle school **(MS)**
    - High school **(HS)**
- **Monitoring/adjusting the new system**
  - "Dials" that can be adjusted (over time)
  - Administrative details
- **Advantages over the Diversity Index (DI) system**
- **Beyond assignment**
  - How can we increase participation?
  - What can make schools more desirable?

Design of the proposed new assignment system

How does the new assignment system work?

Roadmap

- Use ES as a concrete example
- Discuss the proposals for MS and HS
- What are the differences between the proposals for ES, MS, and HS?

Local Assignment with Transfers (ES)

- For each school seat, we have to decide which students have the highest preference at that seat
- The various proposals vary in how they assign preferences to school seats
- The proposal for ES has 2 parts:
  - GE seats
  - Language program seats
- Begin by giving every student a randomly chosen number (i.e. a lottery number)

Who gets preference? (ES)

GE	Does the student…
1. Sibling	have an older sibling at the school?
2. Pre-K	attend the feeder SFUSD Pre-K?
3. Local	live in the attendance area (AA)?
4. CTIP 1	live in CTIP 1 area?
5. Overfill	live in AA that can't fit all local students?
6. Lottery	—

Who gets preference? (ES)

GE
1. Sibling
2. Pre-K
3. Local
4. CTIP 1
5. Overfill
6. Lottery

For GE seats, preference to students is assigned the following way:

(For citywide, simply drop 3. Local)

Highest preference is given to students with an older sibling at that school

2nd highest preference is given to students who attended the feeder Pre-K of that school

Under current demand patterns, there is sufficient space for these students at every GE program

Who gets preference? (ES)

GE
1. Sibling
2. Pre-K
3. Local
4. CTIP 1
5. Overfill
6. Lottery

3rd highest preference is given to local students

- If attendance area is only CTIP 1 or only CTIP 2, the lottery number determines who among those has higher preference
- If attendance area has both CTIP 1 and CTIP 2, local CTIP 1 students get higher preference, then local CTIP 2 students
  - Among each of these groups, the lottery number determines who has higher preference.

Who gets preference? (ES)

GE
1. Sibling
2. Pre-K
3. Local
4. CTIP 1
5. Overfill
6. Lottery

4th highest preference is given to CTIP 1 students who are not local

- Among those, highest preference goes to CTIP 1 students who live in attendance areas (AAs) that can't fit all local students (i.e. Overfilled AAs)
  - Among each of these groups, the lottery number determines who has higher preference

5th highest preference is given to non-local CTIP 2 students who live in AAs that can't fit all local students

- Among those, the lottery number determines who has higher preference

6th highest preference is given to non-local CTIP 2 whose local school can accommodate all local students (i.e. non-Overfilled AAs)

- Among those, the lottery number determines who has higher preference

Who gets preference? (ES)

Language programs
1. Language continuity
2. Sibling
3. Pre-K
4. CTIP 1
5. Overfill
6. Lottery

Preferences + Rankings = Assignments

- We have talked about who has preference at each school seat
- Additionally, students rank the schools in the order in which they truly like them (submitting the true ranking assures each student a more preferred assignment than any other ranking)
- Then we translate these rankings and preferences into assignments via the **Local Assignment with Transfers (L-AT)** algorithm…
- Note that the following all takes place *in the computer* (i.e. we do not really ask all parents and principals to come to Union Square and point at each other…)

Local Assignment with Transfers (L-AT) The big picture

- The general idea is that we temporarily give students seats at schools where they have a high preference and then look for ways we can transfer them to schools they prefer
- To be more concrete, we will go through one step of the AT. The AT consists of repeating this step until no more students can be assigned

One Step in the (Local) Assignment with Transfers

- For every program that still has a seat that hasn't yet been permanently assigned: The computer temporarily assigns one seat to the unassigned student who has the highest preference at that seat
  - *Here, a student may be temporarily assigned to multiple schools*
- The computer then focuses on students who are temporarily holding a seat. It searches for a better reassignment of those students via transfers

A look at transfers in the L-AT

Obvious:

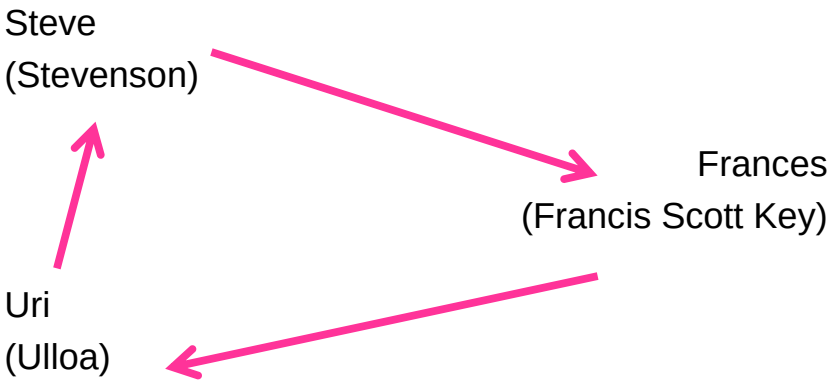
- Any student temporarily assigned to her highest ranked school permanently receives that seat

Finding transfers:

- Every other temporarily assigned student looks around at the other students who temporarily hold a seat. Among those, he points to the student who holds the seat he ranks highest
- **For example:**
  - Steve temporarily holds a seat at Stevenson and among the schools which are temporarily assigned he ranks Francis Scott Key highest
  - Frances temporarily holds Francis Scott Key and among the schools which are temporarily assigned she ranks Ulloa highest
  - Uri temporarily holds Ulloa and among the schools which are temporarily assigned he ranks Stevenson highest.

Transfers in the L-AT

A feasible transfer cycle exists when we can find some set of temporarily assigned students whose arrows form a cycle



Transfers in the L-AT

- The transfers in all transfer cycles are implemented
- The assignments of students who are involved in a transfer cycle are finalized
  - Steve goes to Francis Scott Key
  - Frances goes to Ulloa
  - Uri goes to Stevenson

Assignment with Transfers

- For every program that still has a seat that hasn't yet been permanently assigned: The computer temporarily assigns one seat to the unassigned student who has the highest preference at that seat
- Look for feasible transfers as we just described
- Permanently assign those transferred students

Are there any programs that have seats that are not yet permanently assigned? Is there also at least one unassigned student who has requested one of these programs?

- If Yes to both, then repeat the process
- Otherwise, **STOP**. No more students can be assigned to schools they requested

Initial Guaranteed Assignment with Transfers (MS)

- Every 5th grader in SFUSD will receive an initial placement at their local middle school
  - In case there are not sufficient local GE seats, the student will receive an initial assignment at the closest school with openings
- After having received that assignment, students can decide whether to participate in the Initial Guaranteed Assignment with Transfers (IG-AT)
- Students rank schools they (strictly) prefer to their initially assigned school
- Every student that participates will always receive either his initial assignment or a school he strictly prefers
- **The big idea:** Same as the ES proposal, but students also get an initial, guaranteed assignment

Who gets preference? (MS)

What determines the preference students receive at a program seat?

GE
1. Initially assigned students
2. Local
3. Sibling
4. CTIP 1
5. Lottery

Note that there is always sufficient space for initially assigned students!

Who gets preference? (MS)

Language programs
1. Language continuity
2. Sibling
3. CTIP 1
4. Lottery

Basically the language program has the same preferences over students as for ES, apart from the feeder SFUSD Pre-K preference in ES.

Assignment with Transfers with an Initial Guarantee (IG-AT)

- All students that participate in IG-AT either receive their initial assignment, or a school they rank higher
- Consider Amy who receives an initial guarantee at *Example Middle School*.
- Amy knows that in (IG) AT she will be temporarily assigned to EMS before EMS runs out of seats
- There are 3 possibilities:
  1. Amy has already received another temporary assignment she prefers or she used it to transfer and got permanently assigned to some other school.
  2. Amy has so far unsuccessfully tried to transfer, but now, she is successful, and transfers.
  3. Amy remains unsuccessful in trying to transfer.
- In all cases does Amy either get EMS or a school she prefers

How do the proposals for ES and MS differ?

MS students get an initial guarantee – ES students do not

Why did we not propose this for ES?

1. Sibling Ordering
   - ES: At any GE seat a student with an older sibling has a higher preference than other (local or non-local) students.
   - MS: At any GE seat a local student has a higher preference than a non-local student who has a sibling at that school.

How do the proposals for ES and MS differ?

2. Insufficient number of GE seats
   - ES: There are about 3180 non city-wide GE seats for about 4660 students, i.e. there are simply not sufficient GE seats to give one to every student (this is true even if we open up city-wide GE programs)
   - MS: We have sufficient GE seats since there is a smaller fraction of language program seats

How do the proposals for ES and MS differ?

3. Lack of beforehand knowledge about possible students
   - In ES: Early in the year, we do not yet know which students will attend begin kindergarten in the next year
   - In MS: Every 5th grader will be given an initial local assignment

Diversity Assignment with Transfers (HS)

High schools are split into two sections: One gives higher preference to CTIP 1 students and the other gives higher preference to CTIP 2 students.

GE: CTIP 1	GE: CTIP 2
40% of seats	60% of seats
1. C1-Sibling	1. C2-Sibling
2. CTIP 1	2. CTIP 2
3. Local	3. Local
4. Lottery	4. Lottery

Student Rankings for HS

- The two sections of a program only exist inside the computer
  - Students rank a program without reference to the CTIP section
  - A CTIP 1 student who ranks a program, will internally rank the CTIP 1 section of that program before the CTIP 2 section, and vice-versa for CTIP 2 students
- This means that seats in the CTIP 1 section that cannot be filled with CTIP 1 students will be opened to CTIP 2 students, and vice-versa
- Whether a student is placed in a CTIP 1 or CTIP 2 seat doesn't need to be known outside of the EPC

Properties of Assignment with Transfers

- **AT is flexible:** The preference structure can be changed anytime easily
- **AT is non-wasteful:** There is no other reassignment of students that would make some students happier without hurting some other
- **AT is strategically simple:** Students cannot do better than truthfully rank the schools

Outline

- **Design of the new assignment system**
- **Monitoring/adjusting the new system**
  - "Dials" that can be adjusted (over time)
  - Administrative details
- **Advantages over the Diversity Index (DI) system**
- **Beyond mere assignment**
  - How can we increase participation?
  - What can make schools more desirable?

Monitoring and adjusting over time

The “dials”

- When we say that the new proposal has “dials”, we mean that it is flexible
- When this flexibility is coupled with a monitoring system, we have the opportunity to fine-tune the present proposal to maximize the opportunity for diversity

AT is flexible

- You can decide whether to have an initial guarantee for students, or whether everyone must participate in some version of AT
- You can decide which students should receive highest preference, for each school seat
  - Should students with a sibling at that school receive a high preference?
  - Should local students receive a high preference (L-AT)?
  - Should CTIP 1 students receive a high preference (D-AT)?
- You can decide to split schools (in two) and assign different preferences at seats in each subsection
- You can use different preferences at different schools
  - Language programs and city-wide schools are treated differently than GE programs in the present proposal
  - Should all schools give preference to the same CTIP area?
  - Should some schools be split and others not?

Flexibility without predictability doesn’t help

- Under the current system, we have no reason to believe that the student rankings we have are truthful
- This means that, although we can run simulations based on the rankings that were submitted, these simulations yield dubious results

Monitoring and adjustment under AT

- Systems based on the AT allow parents to tell the truth without fear that they could do better by lying
- With truthful rankings, we can run meaningful simulations
- This means that after every year, we could accurately answer questions like:
  - What if we would have split the high schools 50-50 instead of 40-60?
  - What if we gave preference to CTIP 1 students before local students in ES?
- This allows us to monitor and adjust the assignment system; to fine-tune it to maximize the opportunity for diversity
- **We are more than happy to help with this process**

Administrative oversight

- The biggest priority for operationalizing the new proposal is to make sure that regulations are set up to govern the monitoring/adjustment process
  - Ensure the system achieves its goals
  - Ensure steps are taken to improve performance
  - Ensure that adjustments don't undermine properties such as non-wastefulness and strategic simplicity

Our recommendations

- Beyond what we have discussed, there are a few recommendations we would make in operationalizing the proposal
  - In Boston, parents can rank as many schools as they like. Limiting parents to 7 schools unnecessarily undermines strategic simplicity. For ES, there are over 100 programs!
  - The infrastructure to run simulations to help with the adjustment process is key
- We are happy to help with monitoring and adjustment

Advantages of the new proposal over the current Diversity Index (DI) system

Simulations

- We have run simulations based on the new proposal
- They look essentially the same as previous work
- Of course, it is important to realize that the simulations we run are of dubious accuracy, since we use rankings submitted under the DI system
- However, the unifying theme of the simulations is that they all yield results that are better than outcomes realized in SFUSD schools under DI

Reminders about Assignment with Transfers (AT)

- **AT is non-wasteful:** There is no other reassignment of students that would make some students happier without hurting some other
- **AT is flexible:** The preference structure can be changed anytime easily
- **AT is strategically simple:** Students cannot do better than truthfully rank the schools

DI: wasteful, inflexible, and strategically complicated

- DI is wasteful (as we discussed in earlier presentations)
- But its most important failing might be that it is not strategically simple

Why do we care about strategic simplicity?

For students:

Student assignment should be progressive: Help students who cannot afford to live next to the best schools

Assignments that are not strategically simple can undermine that goal:

1. More affluent parents may have more time and more means to "game" the system in the best possible way.
2. Groups that are supposed to help parents make decisions may and sometimes do (inadvertently) give wrong advice (because advice is not simple to give).

Recommendation to the School Committee: School Superintendent Payzant Memorandum on 5/25/05 states:

"The most compelling argument for moving to a new algorithm is to enable families to list their true choices of schools without jeopardizing their chances of being assigned to any school by doing so."

"A [strategically simple] algorithm *levels the playing field* by diminishing the harm done to parents who do not strategize or do not strategize well."

Fairness rationale for mechanisms in which it is in the students best interest to submit their preferences truthfully

Why do we care about strategic simplicity?

For SFUSD:

When we have the "true" rankings of parents, we can make meaningful comparisons and forecasts between different (strategically simple) assignment methods.

- Switching to another strategically simple assignment system does not change the rankings of parents.
- Right now we can only run "magic" simulations, we have no way of knowing how parents' rankings will change! Simulations now can only provide a rough guideline.

With "true" rankings of parents, we can meaningfully analyze what makes schools desirable, what attracts various groups of students, what can make them more diverse.

Being able to do this is an important aspect of being able to help SFUSD with improving all schools!

Why DI is not Strategically Simple

Students have several reasons to not provide their true preferences over schools: A few examples

1. Sibling preference: Use-it-or-lose-it:
   - Arielle prefers her local school, but it is hard to get into that school.
   - Arielle has a brother, Ben, who goes to her second choice school.
   - If Arielle lists her local school first, she loses any sibling preference at Ben's school.
   - Arielle may be wise to rank Ben's school first to assure that the parents do not have their kids in separate schools of which neither is the neighborhood school.
   - Arielle's decision is not strategically simple

Why DI is not Strategically Simple

2. Ranking is used as a tie-breaker:
   - Take two otherwise identical students: Alec and Ben.
   - Suppose Alec ranks as a first choice a very selective school and Ben does not. Otherwise, they have the same list of schools.
   - If Alec does not receive his first choice: he will be chosen after Ben at every other school!
   - Alec could be really hurt by taking his chances with a selective school!
   - Alec and Ben's decisions which schools to rank is not strategically simple

Beyond Assignment

Two more issues where economists (we) can help you:

1. Participation:

- How can we increase participation?
- Can we make the transition easy?

These issues can be studied, where we basically ask: what is the most effective communication for SFUSD ?

Beyond Assignment

2. How can we change current demand patterns?

- Economists have sophisticated methods to try to understand what drives demand at schools
- How many more students rank a school when we add a language program?
- How many students rank it higher?
- Who are those students?

"Demand analysis" could help deciding where to place various language programs…

Conclusion

- Assignment with Transfers is very flexible:
  - Local AT (ES)
  - Initial Local AT (MS)
  - Diversity AT (HS)
- AT is (in all its variants) strategically simple and non-wasteful
- Strategic simplicity is a bonus not only for students but also for SFUSD:
  - Simulations about other variants of AT are reliable
  - Demand for schools can be analyzed and is meaningful

Additional Recommendations

- Allow students to rank more schools: Any restriction is simply that, a restriction.
- Monitor the system on a regular basis
- Study how we can achieve high levels of participation
- Help with a smooth transition
- Demand Analysis: Study what are the effects of placing language programs in schools…