Closest Types: A Simple non-Zone-Based Framework for School Choice

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1 Motivation

In designing choice menus in school choice, policy makers want to ensure equity of access to quality, while keeping menu sizes not too large to avoid high transportation costs and excessive dispersion of local communities.

While dividing the city into zones and trying to balance the school qualities across zones may satisfactorily accomplish the above in the short term, school quality may change significantly in a decade, and in order to keep zones equitable, boundary lines may need to be re-drawn periodically. However, drawing of boundary lines is somewhat arbitrary at best, and changing of boundaries will always significantly affect those who live on the boundary, which makes revisions difficult.

Closest Types is a simple non-zone-based framework of defining choice menus, in a nutshell:

> **Closest Types:** Schools are classified into types. A school may belong to multiple types. For each type, each student can choose from the closest certain number of schools of that type.

I describe a concrete plan for Boston in Section 2 and illustrate with examples. Observe for now that the choice menu is customized to each family and is centered by definition on where they live. Moreover, the menus are completely determined upon definition of

1. School types.
2. How many closest schools of each type students can choose from.

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The former can be directly rooted in quality metrics and school attributes, while the latter represents the level of quality guarantee the city commits to provide. Generally speaking, a higher number of schools in choice menu increases equity of access and variety of choice, but also increases transportation costs and community dispersion. What parameters to use is thus a trade-off the city must decide. Regardless of the decision, however, once the parameters are specified, Closest Types straightforwardly adapts to future changes in a well-defined way.

2 Proposed Plan for Boston Elementary School Assignment

For Boston elementary school assignment, we observe the following points:

- If quality is similar, most families prefer schools close to home (which makes sense because students are in kindergarten).
- Equity of access to quality is the focus.
- The only available and accepted quality metric is currently Boston Public School (BPS) MCAS rank – averaging 2 years of MCAS performance and growth data, weighing performance to growth 2 to 1, and computing relative ranking within BPS elementary and middle schools.
- Quality measured by BPS rank is on a continuum, and schools show much variation. There is no natural single cutoff that adequately determines what is "quality" and what is not.
- Meeting supply and demand may be a challenge in certain neighborhoods.

Motivated by the above, I propose the following assignment plan for elementary assignment.

Closest Types 1: School types:

- "sufficiently close": any school in BPS walk-zone. (But it also can be distinct from walk-zone; *i.e.* any school within x miles.)
- "exceptional": Top 25% school by MCAS Rank.
- "above average": Top 50% school by MCAS Rank.
- "okay": Top 75% school by MCAS Rank.
- "capacity": a school projected to be accessible even with no priority and bad random number.

Note that schools can count toward multiple types. For example, an "exceptional" school is automatically "above average." (I am only using these labels for ease of exposition; they are based on a very imperfect metric, so should not be interpreted as broad value judgments.)

Choice Menu: Any student can choose from any of the following:

- Any school "sufficiently close"
- Closest 2 "exceptional" schools
- Closest 4 "above average" schools
- Closest 6 "okay" schools
- Closest 3 "capacity" schools

In determining the list of schools from each type, families can simply look at a map showing only schools of that type and identify their closest certain number. The maps showing schools of each type (based on current metrics) are in Figures 1,2,3,4. The final choice menu is a simple merge of the school lists from various types.

I propose to judge distances by Google Maps walk-distance, so families can verify their school lists using Google Maps.

For designation of "capacity" schools, BPS can use past choice data to forecast demand, but it also has additional control because it chooses where to add capacity. For now, I have come up with a list of 23 capacity schools by examining past supply and demand alone.[1] See the list of schools in Figure 4.

The "capacity" schools are included to make sure that this non-zone-based model does not cause serious supply and demand challenges. The inclusion of sufficiently many "capacity" school menu allows BPS to mitigate supply short-falls in one geographic area, thus making it easier for BPS to enroll every student in his/her choice menu. However, if it is the case that BPS can satisfy demand everywhere without needing "capacity" schools, then this can be removed from the model, in which case students only every travel further from home for improved quality.

[1]Specifically, I examined 2010-2011 and 2011-2012 Round 1 choice data, simulated the assignments, and filtered by every non-ELC school with 50% walk-zone set aside that had capacity of at least 24 in both years. Then I sorted by the level of competition from lowest to highest (by examining the random number cutoffs from the assignment simulation), and picked the most accessible 23. For all of these schools, in both 2010-2012, even a non-walk-zone student had more than 70% chance of getting into any of these schools.

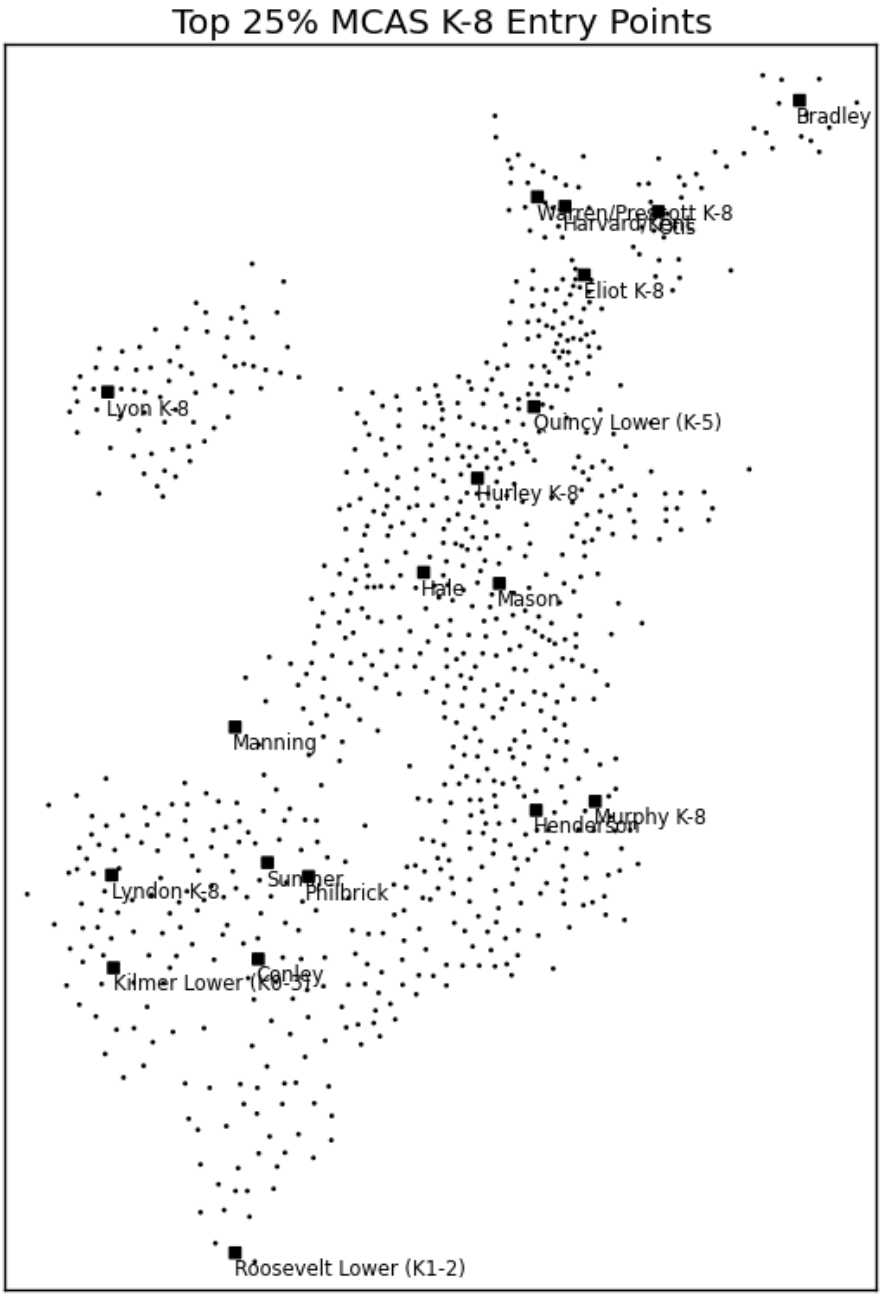

Figure 1: **"Exceptional" Schools (Schools with top 25% MCAS Rank)** Note that this is only an imperfect metric of academics and should not be interpreted as broad quality judgment on the whole school. Only elementary assignment entry points–schools with kindergarten grade–are shown.

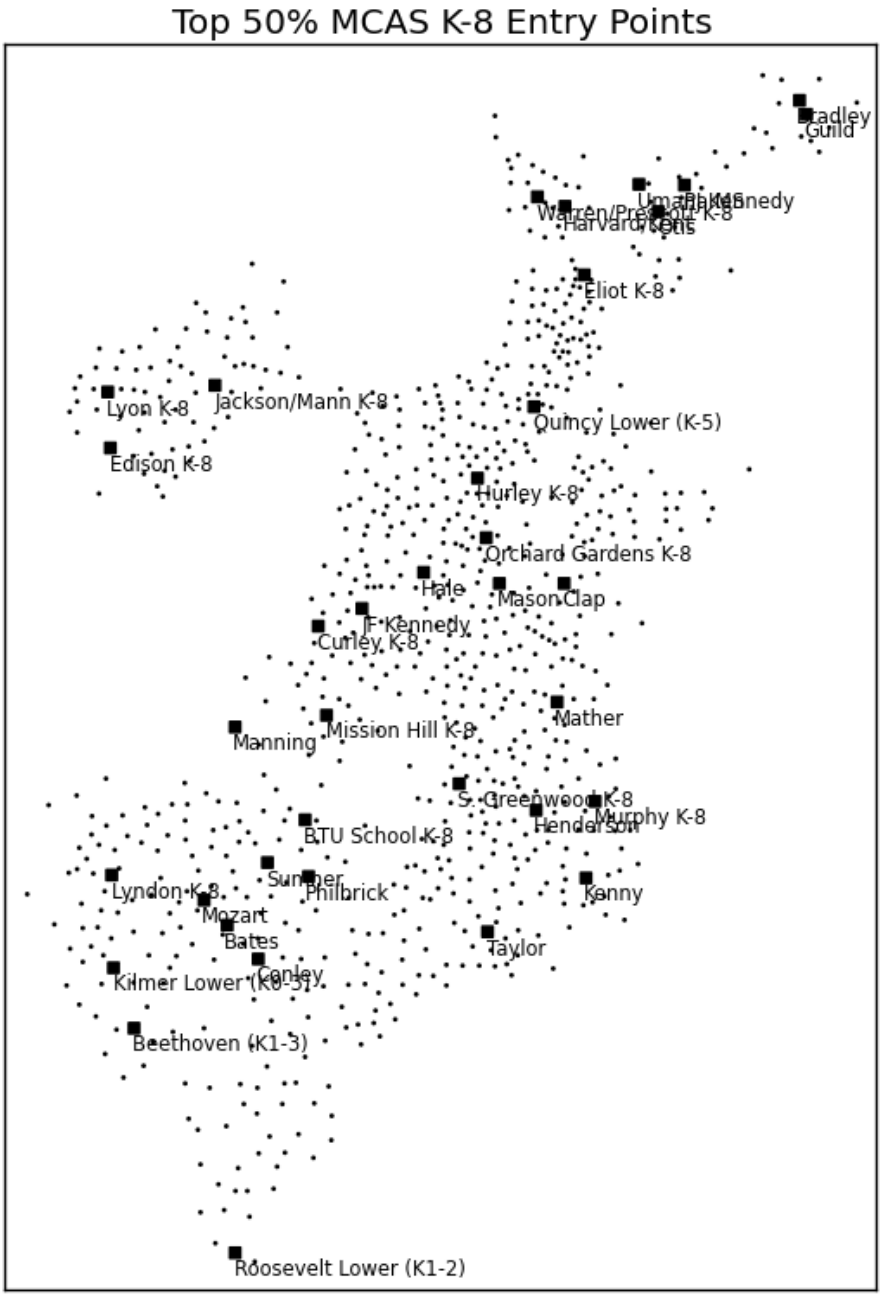

Figure 2: **"Above Average" Schools (Schools with top 50% MCAS Rank)** Note that this is only an imperfect metric of academics and should not be interpreted as broad quality judgment on the whole school. Only elementary assignment entry points–schools with kindergarten grade–are shown.

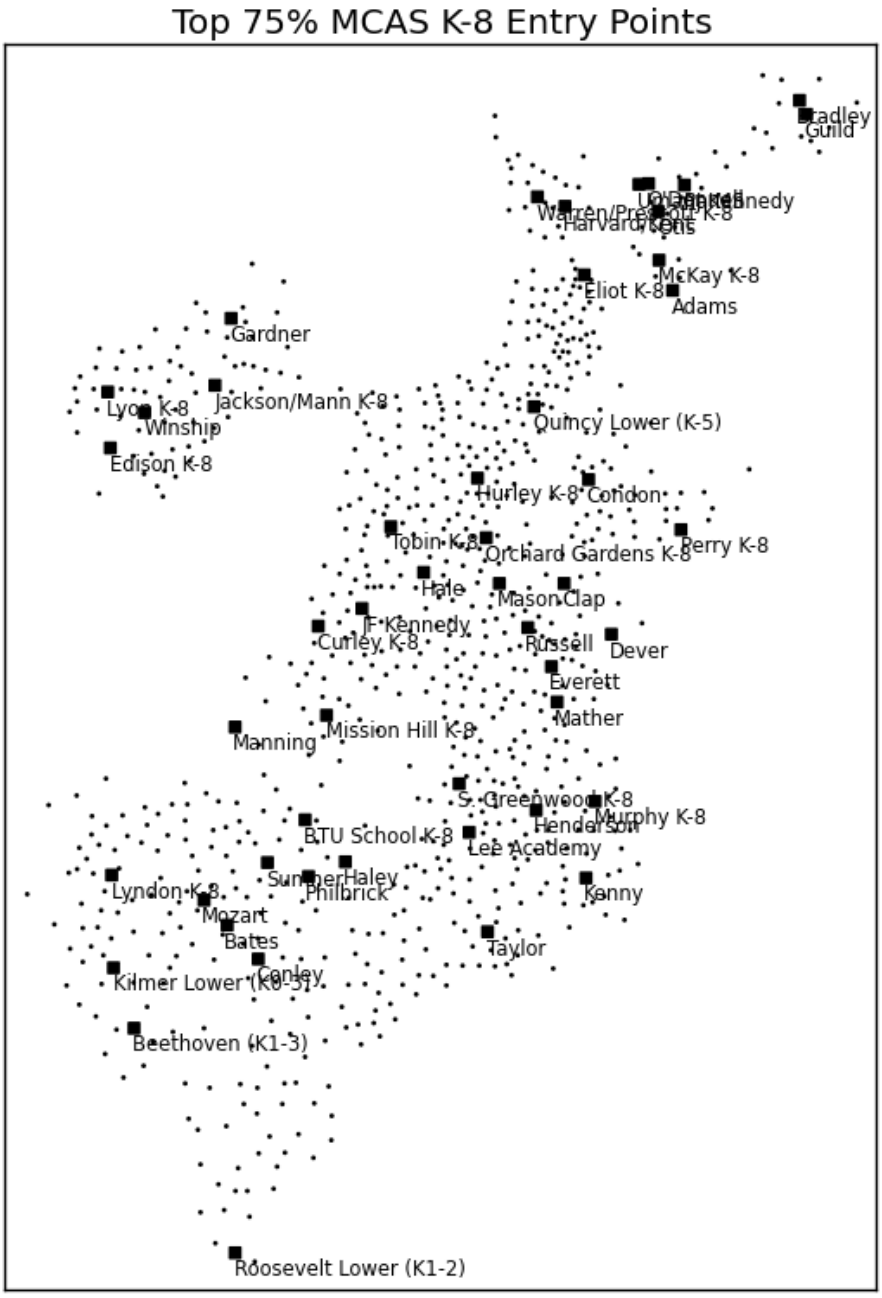

Figure 3: **"Okay" Schools (Schools with top 75% MCAS Rank)** Note that this is only an imperfect metric of academics and should not be interpreted as broad quality judgment on the whole school. Only elementary assignment entry points–schools with kindergarten grade–are shown.

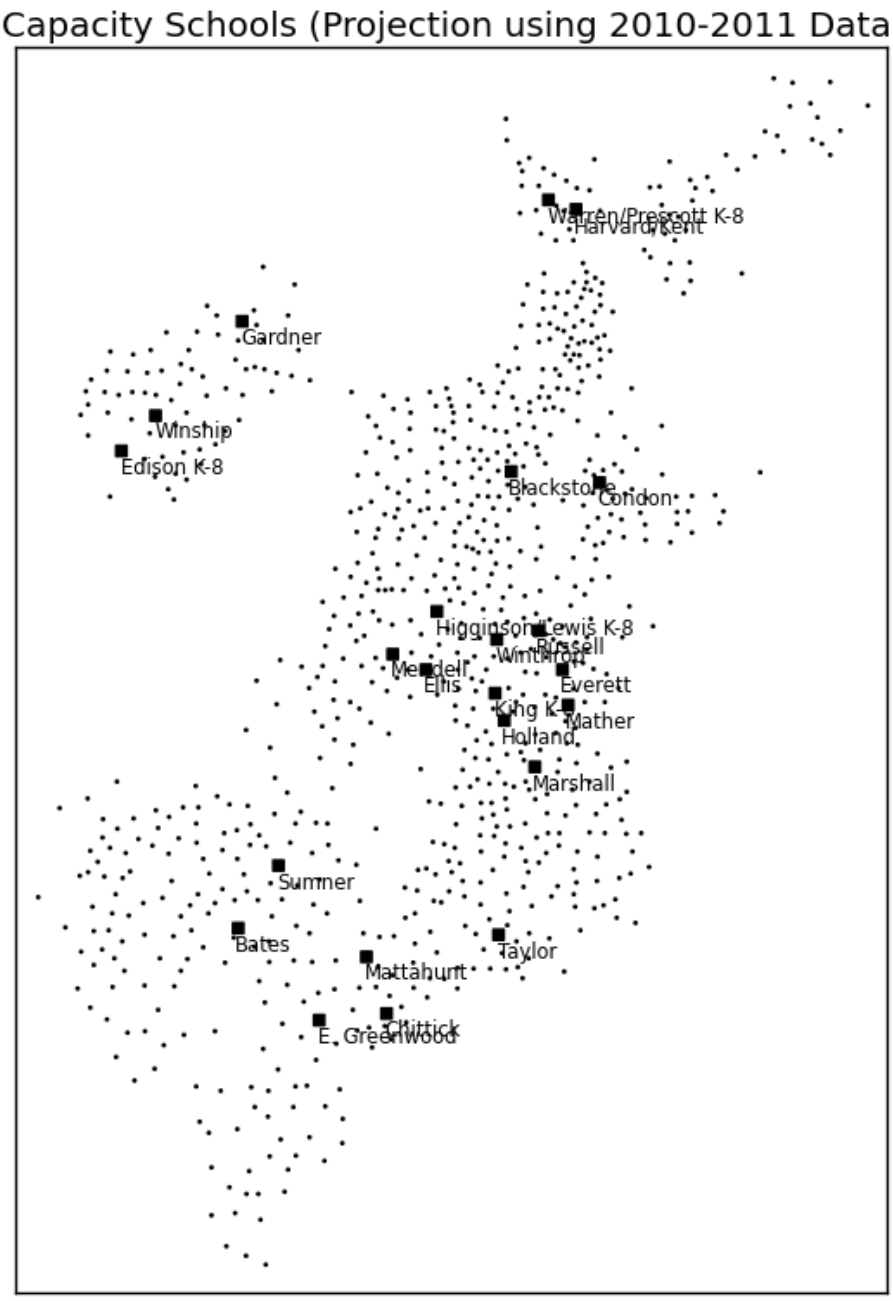

Figure 4: **"Capacity" Schools** These are my own estimates using past years' supply/demand alone; BPS may update this based on its capacity plans.

2.1 Examples

I now show 2 examples to illustrate how families can use the maps in Figure 1,2,3,4 to straightforwardly figure out their choice menu. (Of course this can be assisted by BPS providing an online tool.)

Consider the student who resides at the starred location in Figure 5 (in W. Roxbury). Using the school maps, we find that the school lists are:

- "sufficiently close" (walk-zone): Kilmer, Lyndon;
- Closest 2 "exceptional": Kilmer, Lyndon;
- Closest 4 "above average": Beethoven, Kilmer, Lyndon, Mozart;
- Closest 6 "okay": Bates, Beethoven, Kilmer, Lyndon, Mozart, Sumner;
- Closest 3 "capacity": Bates, E. Greenwood, Sumner.

So the merged list is: Bates, Beethoven, E. Greenwood, Kilmer, Lyndon, Mozart, Sumner. See Figure 5 for a map. The final choice menu also contains Hernandez, which is citywide.

Note that in this example, the student already has sufficiently many quality schools (with respect to every threshold) locally available, so the quality lists merge to be simply the closest 6 schools. However, there are not enough capacity schools in the closest 6, so E. Greenwood is also added to help BPS in eventually enrolling every student to an option in his/her menu.

As another example, consider the student who resides at the starred location in Figure 6 (in Mattapan). The school lists are:

- "sufficiently close" (walk-zone): Chittick, Ellison/Parks, Lee, Mattahunt, Taylor, Young Achievers;
- Closest 2 "exceptional": Henderson, Philbrick;
- Closest 4 "above average": Henderson, Kenny, S. Greenwood, Taylor;
- Closest 6 "okay": Haley, Henderson, Lee, Kenny, S. Greenwood, Taylor;
- Closest 3 "capacity": Chittick, Mattahunt, Taylor.

The merged list is: Chittick, Ellison/Parks, Haley, Henderson, Lee, Kenny, Mattahunt, Philbrick, S. Greenwood, Taylor, Young Achievers. See Figure 6 for a map. The final choice menu also contains Hernandez, which is citywide.

In this example, the closest schools provide enough capacity (3 "capacity" schools already in walk-zone), but they do not provide the quality guarantees specified. Therefore, further away schools are added to provide the quality guarantees. Nevertheless, it is always the closest such schools that are added so choice options are still relatively close to home.

Under this design, students who have sufficient locally available quality and capacity will essentially get closest 6-8 schools. Students who lack local capacity will have added to their menu the closest schools that may provide this capacity. Students who lack local quality will have added to their menu the closest schools that provides this quality. In general students only travel further from home for either quality or capacity that is not locally available. By using the closest schools that can satisfy the quality guarantees in menu, the Closest Types models optimize for proximity to home subject to providing the needed quality guarantee.

The 2-4-6-3 parameters in Closest Types 1 offers choice menu roughly the size of in a 10-zone plan. If we deem this to be insufficient number of choices, I propose the following, which offers number of choices similar to in a 6-zone plan.

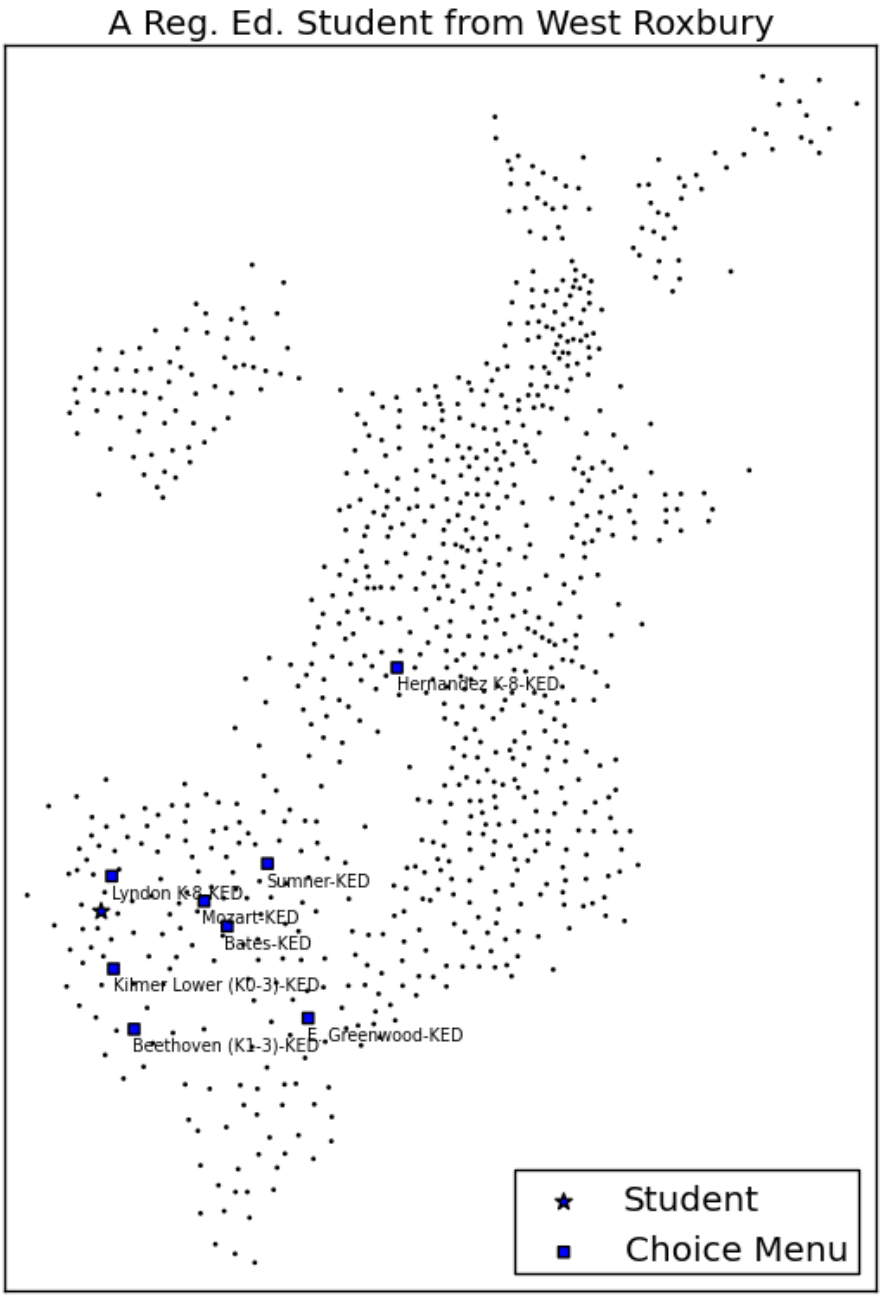

Figure 5: **Example of Choice Menu for Reg. Ed. Student from West Roxbury** (Based on 2-4-6-3) parameters. Note that because there are enough quality schools of every threshold locally available, the quality lists simply merge to form the closest 6. E. Greenwood is added to provide a third "capacity" school.

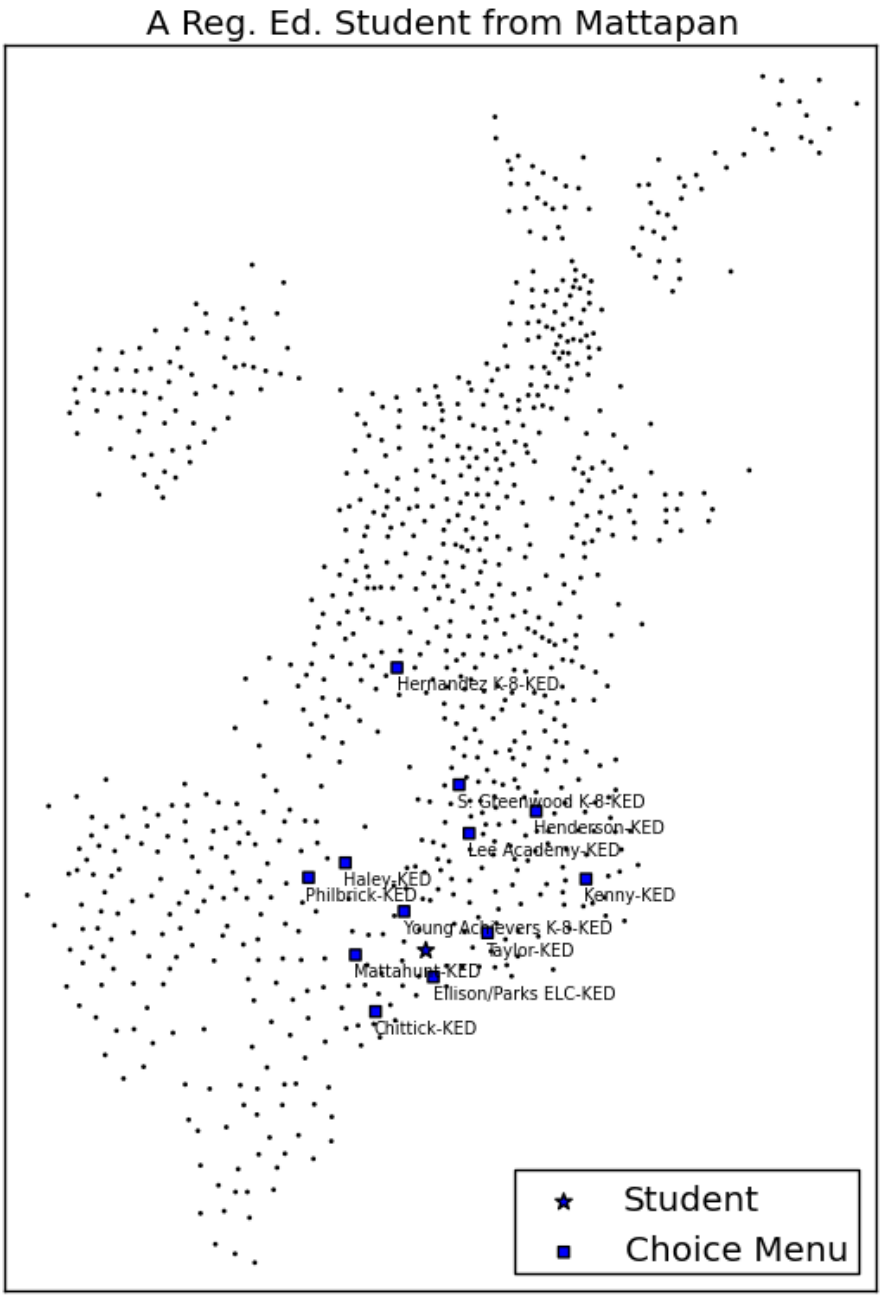

Figure 6: **Example of Choice Menu for Reg. Ed. Student from Mattapan** (Based on 2-4-6-3) parameters.

Closest Types 2: Same as Closest Types 1 except use parameters 3-6-9-3 instead of 2-4-6-3. *i.e.*

- Any school "sufficiently close" (walk-zone for now);
- Closest 3 "exceptional";
- Closest 6 "above average";
- Closest 9 "okay";
- Closest 3 "capacity"

3 Bigger Picture

3.1 Adapting to Changes Over Time

Both Closest Types models can straightforwardly adapt to

- **changes in quality metric:** If a more statistically stable, comprehensive, and confounding-factor-free quality metric becomes available, we can simply adopt that instead of MCAS Rank. This only changes the typing of schools, but the underlying framework remains the same.
- **changes in school quality:** Again this only changes the typing of schools, but the underlying framework remains the same. Another beneficial property of Closest Types is that changes mostly occur in the periphery, but the closest to home schools remain in menu: if one of the "exceptional" schools in menu changes to only "above average," it will still remain in menu if it's one of the 4 closest "above average." Only if it is further away (not among closest 4 "above average" nor closest 6 "okay" will it actually fall out of menu). In every case, another "exceptional" school is added to replace it if the minimum requirement is not satisfied.
- **changes in demographics:** When residential patterns change, demand in certain neighborhoods may exceed supply. This is handled within the Closest Types framework by adjusting capacity in schools, or by updating the capacity schools list. (For example if a certain neighborhood has a population boom and insufficient capacity, the nearby capacity schools may lose their "capacity" status and further away capacity schools can be used to help meet demand.)

However, changing of choice menu should only happen on a longer time scale (5-10 years), because the necessity of grandfathering requires BPS to maintain bus routes for current students even when choice options change. Moreover, changes should be announced a few years ahead of time to maintain predictability to families.

3.2 Increased Demand for Higher Quality Schools

One effect of Closest Type models is that it may increase demand for higher quality[2] schools, because these schools are offered to a larger residential area. For example, while a below average but "okay" school is added to a student's choice menu if it is among the closest 6 "okay" schools, an "exceptional" school is added if it's among the closest 6 "okay," closest 4 "above average," or closest 2 "exceptional." So higher quality schools have more opportunities to be added. Inevitably this results in relatively more applications to these higher quality schools.

Whether this is desirable or undesirable is unclear. On one hand, if we really believe in our quality metric, then we may be glad that families are choosing more in accordance with our metric. (This alleviates concerns that some families may be choosing in an uninformed way: if we mostly only give them quality

[2]More precisely, schools that score higher on the specified quality metric

choices, in some sense they cannot "choose wrongly.") On the other hand, more families would be competing for quality seats, resulting in reduced access for the marginal individual, because roughly speaking,

$$\text{access to quality for a student} = \frac{\text{\# of quality seats}}{\text{\# of students competing for quality seats}}$$

So if more students are competing for quality seats but the total number of such seats remain the same, the denominator increases while the numerator stays the same, so access for the marginal individual decreases. But it is unclear whether this decrease is good or bad because it is not caused by inequitable allocation of quality seats but an overall greater demand for quality seats by Boston's families. The numerical effect of this is simulated in [1]. In the end, the most important task is to increase the numerator–the number of quality seats.

3.3 What if Closest Quality Schools Lack Capacity?

While the menus in Closest Types models include a certain number of quality choices at all thresholds, students may still have low access to some of these because of lack of capacity, high competition, or low priority. The full effect of this on the current system is simulated in [1]. However, this may better be tackled by increasing capacity in quality schools rather than by adapting choice menus. This is because choice menu should only be adapted on a 5-10 year time scale to avoid high transportation overhead and loss of predictability, while capacity at BPS is reviewed yearly and can be added under much shorter notice.

The methodology in [1] creates realistic "access to quality" maps that BPS can use to pinpoint the areas in which there is insufficient capacity at closest quality schools, and can be used as a guide to most efficiently add capacity to maintain equity of access to quality. The maps also pinpoint areas where improvements in school quality is most needed, and can help in planning where to focus resources to improve schools.

3.4 What Happens to the Lowest Performing Schools?

In both Closest Types models, the lowest 25% MCAS schools are only added to a student's menu if it is either "sufficiently close" or one of the 3 closest "capacity" schools. Roughly speaking, this means that

- Larger bottom 25% MCAS schools will serve the "sufficiently close" students and be a provider of supply for nearby students who either choose to go there or those who will not be assigned at all.
- Smaller bottom 25% MCAS schools will serve the "sufficiently close" students only. Until their academics improve, they effectively become neighborhood schools, and can thus synergize with development of school-centered local support structure.

One possible concern of the above is that lowest performing schools situated in areas of low socio-economic status may have higher proportion of student population with low socio-economic status, since the students are only coming from the neighborhood. However, this can be countered to some extent by investing in the school to expand capacity to be a "capacity" school, which allows it to receive families from further away, and thus may provide some socio-economic balance. A low-performing school that also has "capacity" status may serve as a site for "family compacting"–allowing families from further away to compact together to come and try to mobilize resources to affect change for the better. How exactly will this dynamic play out is yet to be empirically analyzed.

3.5 Supporting a Network of Specialized Programs

While the proposed plans currently cover only Regular Education programs[3], the Closest Types framework can support equitable allocation of specialized programs as well. This is done via adding more types. Examples of things we may want to add to students' menu include:

- The closest 2 schools with extended hours.

[3]Other programs are added to the menu according to separate, BPS-designed zone overlays

- The closest Early Learning Center, if within 2 miles. (The distance cap is due to transportation constraints of the city and the sparsity of such centers.)
- The closest bilingual Spanish immersion program. (If we have a network of these built up across the city.)
- The closest 2 Magnet schools. (If we decide to build a network of these.)

Whether or not to add some of the above types and how many of each we want to provide is again a decision by the city based on balancing the benefit of providing these options to every student, and costs in transportation and effects on community cohesion.

Moreover, instead of a zone-based English Language Learner (ELL) overlay, we may try something as follows.

- The closest 2 eligible language-specific ELL program, if within 3 miles. (Has to be in own language to be eligible; the distance cap is to maintain a feasible level of transportation commitment, because these programs may only exist in a few parts of the city.)
- The closest 3 eligible ELL program. (Either multi-lingual or language specific).

However, the potential effectiveness of this to serve ELL students is yet to be analyzed.

4 Comparison with Grouped School Model

My earlier proposal of a non-zone-based approach for constructing choice menu is called Grouped Schools. Roughly speaking, it is as follows:

- Pair schools by MCAS Rank, so that in each pair the average MCAS Rank is roughly average. Some schools may not be paired if its MCAS is already at least roughly average.
- Each student's menu is the 4 closest schools, plus any additional "sufficiently close" school (*i.e.* walk-zone) plus any paired partners of these schools.

This was designed to accomplish the following:

1. Students always have "sufficiently close" schools in menu.
2. Every student has on menu at least 4 schools whose MCAS is at or above average.
3. For students from a neighborhood with bad lottery number, their assignments tend to be focused to a few schools (*i.e.* perhaps the schools in the quality pairs that are relatively less demanded), thus maintaining some community cohesion.
4. School groupings can be updated to adapt to changes in quality.

Closest Types 1 also accomplish the above: it accomplishes the first point as "sufficiently close" schools are always included. It accomplishes the second, and in fact goes beyond Grouped School and gives the *closest* 4 above average schools. It accomplishes the third point via the "capacity" schools. It accomplishes the fourth point in a simpler and well-defined way. (For Grouped School, how to group is not well-defined, especially when we already have a set of groupings and only have a few free links to work with. Sometimes the pairings may end up connecting far away schools, which is intuitively unattractive.)

Another attractive idea in the Grouped School model is that schools may partner to form best practices, or even merge to form a bigger K-8 pathway. However, this can still happen independently from the school assignment process, so can also occur in Closest Types.

The only potentially setback in Closest Types is that it does not allow the pairing of schools based on socio-economics. However, since families may self-segregate through their choices, so it is questionable how much socio-economic diversity socio-economic school pairings can provide. It is also questionable whether the potential education benefit justifies the increased travel distances.

On the other hand, Closest Types models provides quality guarantees at various thresholds (instead of just above or below average), and better optimizes for closest to homes (since options are defined to be the closest such). It also allows more flexible management of supply/demand through capacity schools. These gains, along with its simpler adaptation procedure, convinced me to replace my earlier proposal with Closest Types.

References

[1] Parag A. Pathak and Peng Shi. Simulating alternative school choice options in boston. Technical report, MIT School Effectiveness and Inequality Initiative, 2012.