Simulating Alternative School Choice Options in Boston - Main Report*

Parag A. Pathak Peng Shi†

MIT School Effectiveness and Inequality Initiative‡

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Contents

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†Pathak: Massachusetts Institute of Technology and NBER, Department of Economics, email: ppathak@mit.edu and Shi: Massachusetts Institute of Technology, Operations Research Center, email: pengshi@mit.edu.

‡http://seii.mit.edu/

1 Executive Summary

This report evaluates alternative school choice options for Boston Public Schools (BPS) using demand analysis based on historical data on families' choices under the Boston student assignment plan. Using demand estimates, we evaluate the proposed alternative assignment plans by simulating how families would choose schools in these plans and how this interacts with the assignment algorithm. Our approach is to examine what would have happened in Round 1 of 2012-2013 had a new assignment plan been implemented in that year.

The aspects we analyze include:

- Equitable Access to Academic Quality (as measured by school MCAS)
- Access to Top Dream Choice
- Access to Top Menu Choice
- Bus Coverage Area
- Diversity (Socioeconomic and Racial)
- Community Cohesion (estimated # of same grade neighbors who can travel to school together)

> The MIT School Effectiveness and Inequality Initiative (SEII) does not take a position on the overall merits of a particular plan including the independently developed plan by Peng Shi, nor does this report make a final recommendation. Rather it clarifies and quantitatively estimates tradeoffs among the plans, with the aim of helping policymakers and the community select a plan based on their own priorities, and the needs of Boston Public Schools and the city.

The plans analyzed in this report include all of the original BPS plans (see BPS (2012)), a new BPS zone-based plan, and two non-zone based plans. The new zoned plan was developed by BPS and has 10 zones. The two non-zoned based plans, called Closest Types 1 and Closest Types 2, were developed by Peng Shi to replace the earlier Grouped School models. These two plans are based on the *Closest Types* concept: families are able to rank the closest schools, plus a certain number of closest top 25% MCAS schools, a certain number of closest top 50% MCAS schools, a certain number of top 75% MCAS schools, and a certain number of capacity schools. For the list of these school types, maps, examples, and full description, see the separate and independent write-up contained in Shi (2013). Closest Types 1 has choice menu size comparable to a 10-zone plan, while Closest Types 2 has choice menu size comparable to a 6-zone plan. In the future, these plans may change due to community feedback or other considerations. To avoid ambiguities, we precisely describe the versions analyzed in this report in Section 3.

For clarity of exposition, this report focuses on comparing the status quo with the three new plans. We report these plans based on guidance from BPS, who recommended this shortlist after seeing the preliminary results for all plans. The Graph appendix (Pathak and Shi 2013a) contains analysis of all of the original BPS plans. Detailed information on the simulation methodology is described in the Technical Appendix (Pathak and Shi 2013b).

The analysis shows that the selection of an assignment plan involves tradeoffs on a number of dimensions. Roughly speaking,

- A plan with a larger choice menu offers more equitable access, more access to top dream choice, and greater diversity; however, this comes at a cost of longer distance traveled, higher transportation costs, and lower levels of community cohesion.

- A plan with a smaller choice menu with options closer to home, decreases travel distance, lowers transportation costs, and improves community cohesion; but this may lower access to quality for some, decrease the access to dream choice, and decrease diversity.

- Zone-based plans have advantages of long-term predictability, ease of adaptation and description (since the current plan is zone-based), and time-proven implementability.

- Non-zone-based plans may more easily adapt to changes in school quality and demographics, but require care in implementation and explanation to ensure predictability.[1]

The report is organized as follows. In Section 2, we outline our methodology at a high level. Additional details are in the Technical Appendix (Pathak and Shi 2013b). Section 3 provides a precise description of the plans analyzed. In Section 4, we describe the metrics we use to evaluate plans and define precisely how they are computed and what they represent. In Section 5, we summarize our findings and compare plans side-by-side using these metrics. Section 6 contains more details for the status quo and the new plans, including breakdowns by English Proficiency status, socioeconomic status, race, and neighborhood. In the last section, we report the effects of processing order changes and changing the walk-zone set aside percentage.

For clarity, in this report we focus on grade K2, and most of the statistics are shown for "new families" (non-continuing, non-sibling) because these are the primary population affected by assignment plan reform. (See the beginning of Section 5 for more discussion.) In all of the analysis, we assume the ELL overlay. For analysis of grade K1, additional graphs, and analysis of old BPS plans, see the Graph Appendix (Pathak and Shi 2013a).

2 Overview of Methodology

We simulate what would have happened in Round 1 of the 2012-2013 school year had an alternative assignment plan reform been implemented for that year. In our simulations, we assume that the

[1] For suggestions on how this might be done, see the independent write-up in Shi (2013).

following remain as they were in Round 1 of 2012.

- The set of students who apply to BPS;
- The set of schools and programs available, as well as the corresponding capacities;
- The information on schools and programs given to families.

Since the assignment plan changes families' choice menus, it is necessary to predict how families would choose given new choice menus. To do this, we fit a multinomial logit discrete choice model using 2012-2013 school year Round 1 choice data, pooling together grades K1 and K2. The model includes:

- Fixed effects for each school: a single dimensional variable for each school which captures any school level attribute that makes a school more popular in general than another–academics, teacher/principal effectiveness, safety, atmosphere, etc. We do not disentangle these components from one another, but simply use it to represent a scalar index for each school.
- Fixed effect for every program code: *i.e* KED, BES, KEM, etc. This is a scalar index that captures the popularity of particular programs over others.
- Distance and square root of distance (measured by Google Maps walking distance). The square root is to allow for fixed costs in travel, as might be expected if the difference in distance between two nearby schools is more important than the difference in distance between two far away places.
- School and Program Affinities. These variables capture taste differences for schools in an applicant's walk zone; whether an applicant has a sibling at the school; and whether a school is the present school of an applicant.
- Interactions between the student's race and the school's racial composition. These interactions allow applicants of particular demographic groups to have systematically different preferences for school characteristics.
- Interaction between student's lunch status and the school's % Free lunch. These interactions allow applicants of particular socioeconomic groups to have systematically different preferences for school characteristics.

Using a demand model for simulation is predicated on the following main assumption:

Assumption 1 *Families choose schools under new menus similar to how they chose in the past.*

The Technical Appendix reports in detail on the assumptions underlying the demand model and evidence on the credibility of this assumption. We use 2011-2012 choice data and find it captures the main patterns of demand in 2012-2013 choice data–not only for all students together but also when broken down by race, by socioeconomic status, by grade, by English proficiency status, and by neighborhood. Since demand estimates from 2011-2012 are a useful guide for choice behavior in 2012-2013, they may serve as a guide for choice behavior under alternative assignment plans. We also simulated assignment outcomes using our simulated choices (fitted from 2011[2] data) and

[2]Whenever we refer to 2011 data, we mean the choice data for the 2011-2012 school year.

compared to actual outcome (in 2012[3]). Details of our model, the estimates, and validation are given in the Technical Appendix (Pathak and Shi 2013b).[4]

To estimate models incorporating significant preference heterogeneity, we pool together applicants from grades K1 and K2. We also study only non substantially-separate students. Table 1 tabulates descriptive statistics of the student set represented by the data provided to us by Boston Public Schools (with which we base all simulations in this report). It is important to note that the simulation is most adequate for explaining aggregate patterns rather than for fine subgroups.

Since we do not model outside options (non-BPS alternatives), our demand model only predicts families' relative preferences between BPS programs. It does not predict how many programs they will rank in their choice list or how these options compare to outside-BPS options like charter or parochial schools or METCO. However, for our simulations, it is important to know how many choices families rank because if students rank more schools, it increases the school competition. For experiments with different assumptions on lengths of choice lists, see the Technical Appendix. Based on our experiments, we make the following behavioral assumption:

Assumption 2 *Families find as "acceptable" only their top 10 choices in menu. In other words, they prefer their outside option to their 11th choice.*

This assumption is convenient from a technical perspective because it allows us to truncate everyone's simulated choice list at 10, rather than the unrealistic alternative that everyone ranks every program in their menu. As shown in the Technical Appendix, this provides an adequate approximation of the overall levels of competition in the data.[5] However, it is worth emphasizing some limitations of this assumption:

- Offering more choices may make some previously acceptable option not acceptable.
- Removing choices may make some previously unacceptable option acceptable.

In other words, whether a school option is acceptable to a family is directly influenced by the menu offered, so that regardless of their menu their top 10 and only their top 10 choices are acceptable. While families' preferences may be affected by what is offered and how options are advertised, it is unclear whether the stringent cutoff at top 10 reflects reality. Nevertheless, this was a necessary assumption to keep the empirical framework logically self-consistent.

The demand model along with the cutoff of 10 choices allows us to simulate an entire dataset of projected choices under alternative assignment plan options. We can then take these preferences as an input into the our replication of the BPS assignment algorithm. For evaluating the status quo, we adopt current processing order: walkers first apply to the walk half, non-walkers apply to the non-walk half. For all new plans, we evaluate using the new "compromise" processing order: both walkers and non-walkers apply to a non-walk "quarter," then to the walk half, then to the left over non-walk "quarter." Implementation details are in the Technical Appendix.

To minimize the role of random noise in our simulations in the comparison of plans, for each run of simulation, we use the same random variable realizations in our demand model, and for each

[3]Round 1 choice data for the 2012-2013 school year.

[4]Readers interested in additional details on Boston's student assignment algorithm are referred to Abdulkadiroğlu and Sönmez (2003), Abdulkadiroğlu, Pathak, Roth, and Sönmez (2005), Abdulkadiroğlu, Pathak, Roth, and Sönmez (2006), and Pathak and Sönmez (2008).

[5]In fact, it represents an environment that is slightly more competitive than in actual data, as the modal choice list length is 5 and mean is 4.2. However, in case families rank more choices than historically, this provides a conservative benchmark which under-estimates access rather than over-estimates it.

Type	Number of students	% of Sample
All	6696	100%
Present Schoolers	2271	34%
New Applicants (No Present School)	4625	69%
New Families (No Sibling, No Present School)	3468	52%
K1	2666	40%
K2	4030	60%
Black	1436	21%
White	1059	16%
Asian	445	7%
Hispanic	2892	43%
Other	196	3%
Missing	668	10%
Free Lunch	3251	49%
Reduced Lunch	236	4%
Non-Free Reduced Lunch	778	12%
Missing	2431	36%
LEP (Limited English Proficiency)	2675	40%
All-Bri	317	4.7%
Back-Bay-BH	32	0.5%
Central Bos	151	2.3%
Charlestown	201	3.0%
East Boston	856	12.8%
Fen-Kenmore	51	0.8%
Hyde Park	401	6.0%
Jamaica Pla	398	5.9%
Mattapan	491	7.3%
N. Dorchest	351	5.2%
Roslindale	562	8.4%
Roxbury	969	14.5%
S. Boston	224	3.3%
S. Dorchest	930	13.9%
South End	301	4.5%
W. Roxbury	461	6.9%

Table 1: Student set used for our analysis. (Non-substantially separate SPED K1, K2 applicants in 2012-2013 Round 1 choice.) The data file we were provided is missing race information for 668 students and lunch information for 2431 students.

student we use the same tie-breaking random number across plans. More precisely, we first generate a choice file with no truncation and assuming every program is citywide. This is the common starting point for comparison of all assignment plans. Next, for each assignment plan, we remove the choices not in menu, and truncate the length of the rank order list at 10. This generates a choice data file for each plan. We then compute 25 independent runs and all our results are based on student-by-student averaging of the 25 runs. This produces a consistent yardstick for comparing the plans.

One must take caution in interpreting our results given they are counterfactual forecasts of human behavior. We list some important caveats below:

- We use 2012 students and school capacities. After the assignment plan reform, it is possible that the set of students who apply to BPS changes significantly. Moreover, there may be future supply adjustments not included in our analysis.
- Our analysis is based on only Round 1 data. We do not analyze subsequent rounds or school enrollment decisions, so our simulations reproduce only offers of school places by the algorithm.
- Our model for demand
  - Assumes that families rank schools based on their own preferences only (so we do not model the potential that families chose together).
  - Does not model outside options, but assumes that every family ranks up to 10 programs. (Our reasoning for this choice is given in the Technical Appendix.) However, it is possible that many families compare non-BPS options to BPS options when submitting their preferences.
  - Does not capture unobserved student characteristics. (For example, a family may have taste for music programs, so may consistently choose programs that rank schools that have better music programs. Since taste for music is not observed in our data, we cannot capture this.)
  - Does not project changes to quality, how schools are advertised, or other factors that may cause families to rank schools differently in the future.
- We are evaluating school quality by relative ranking of BPS schools by MCAS, but MCAS fluctuates significantly from year to year so this quality metric may contain significant amounts of random noise.
- Assumption 2 may not accurately capture family's actual threshold of acceptable schools.

Therefore, one should view the results of our analysis as an imperfect approximation. We recommend that in comparing plans it is safer to take a holistic view (examining many metrics and intuition) instead of relying solely on a numerical comparisons on only one dimension.

3 Precise Definitions of Plans We Simulate

In this section we describe the plans that we simulate. Note that due to community feedback and other considerations, these assignment plans may be altered, so the plans we simulate may not completely match what would be implemented in the future.

This report corresponds to our best understanding of the proposed assignment plans as of January 19, 2013.

The definition of walk zone and the school attributes we use correspond to what they were in 2012-2013 Round 1, instead of any anticipated changes. This is because as described in Section 2 we are grounding our analysis in 2012-2013 Round 1, so as to be able to validate the simulation with observed data. To be explicit:

- At the time of 2012-2013 Round 1, the definition of walk zone was based on a geocode to school correspondence (calculated by drawing a circle with 1-mile radius centered at a school and adding the entirety of any geocode that the circle touches). If there are changes to walk zone definitions, these are not incorporated in the analysis. We are using the 2012-2013 Round 1 definition of walk zone in our simulations.

- The schools and programs we use are the ones available in 2012-2013. Some schools have changed since then. For example, schools may move locations, there may be new schools or other schools may close down. We do not account for these changes or potential future changes.

3.1 Program Eligibility

Our interpretation of program eligibility (what programs a student can rank) is as follows:

- Any student can apply to a regular education program, which includes the following program codes: KED, KEM, REG, REM, IEE, TEE. (These are the only regular education program codes in our dataset.)

- Any Limited English Proficiency (LEP) student can apply to both regular education programs and multi-lingual English Language Learners (ELL) programs.

- A LEP student can also apply to a language-specific ELL program of his/her own language.

Since our simulations do not analyze substantially-separate special education students, the above description characterizes program eligibility at the K1-K2 level.

3.2 Zone Maps

Since our geographic data is based on geocodes, we only approximate zones using a geocode-to-zone correspondence. We approximate a student's location using the centroid of the geocode. For walk zone, we use the same file containing the geocode to school correspondence that BPS used to define walk zone in 2012-2013 Round 1. In our interpretation of a zone plan, a student's choice menu is the union of:

- Any eligible, regular education program in a school within the student's zone.

- Any eligible, ELL program in the student's ELL cluster (according to the ELL overlay).

- Any eligible program in a school within the student's walk zone.

- Any eligible program in the student's present school or in a school in which the student has a sibling.

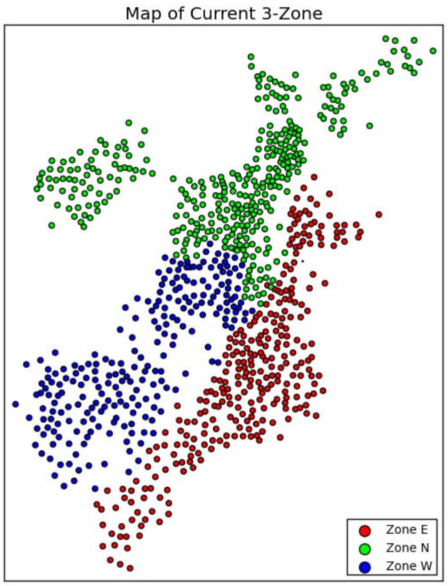


Figure 1: Map of the current 3 zones. Each point corresponds to a geocode.

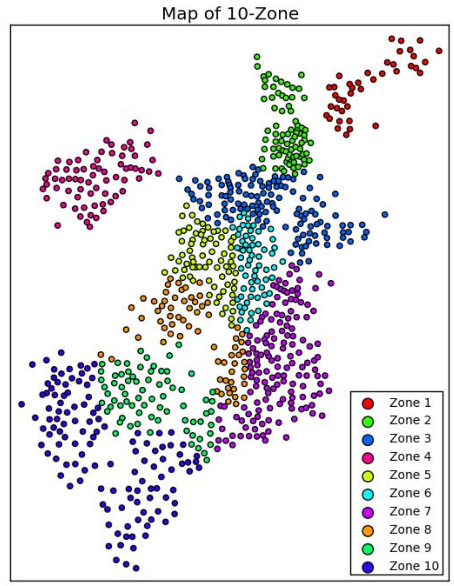


Figure 2: Map of the 10-Zone model we analyze in this report. Each point corresponds to a geocode.

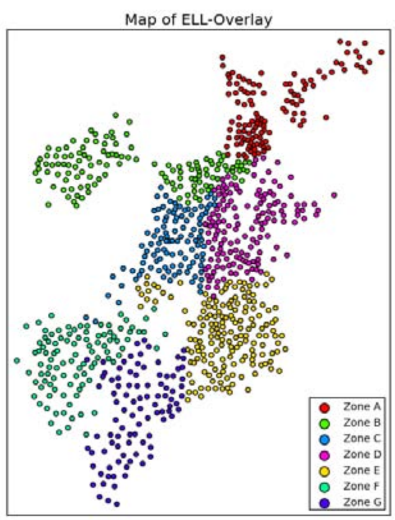


Figure 3: Map of the ELL overlay we analyze in this report. Each point corresponds to a geocode.

For the geocode to zone correspondence we use, see Figure 1 for the current 3-zone, Figure 2 for the 10-Zone, and Figure 3 for the ELL overlay.

For the Status Quo, we use the 3-zone map (Figure 1) to allocate both regular education and ELL programs. For non-Spanish language-specific ELL programs, because we observe in data that students sometimes can choose out of zone and out of walk zone, we interpret these programs as citywide in the status quo. For the 10-Zone, we use the 10-zone map (Figure 2) to allocate regular education programs, and we use the ELL-overlay (Figure 3) for all ELL programs.

3.3 Closest Types

In this report, Closest Types 1 refers to the following: a student's menu consists of

- Any eligible, regular education program in a school that is:
  - Among the closest 2 top 25% schools. (See Figure 4)
  - Among the closest 4 top 50% schools. (See Figure 5)
  - Among the closest 6 top 75% schools. (See Figure 6)
  - Among the closest 3 capacity schools. (See Figure 7)
- Any eligible, ELL program in the student's ELL cluster (according to the ELL overlay).
- Any eligible program in a school within the student's walk zone.
- Any eligible program in the student's present school or in a school in which the student has a sibling.

To measure distances, we use the the Google Maps walk distance between the student's geocode and the school's geocode. Top 25%, top 50% and top 75% are measured using the BPS MCAS rank (see Section 4.1 for definition). They denote the first column, first two columns, and first three columns of Table 2, respectively. See Figures 4, 5, 6, and 7 for maps of these schools. A family can look at each map separately, find their closest specified number of schools from each map, and merge them to form their menu of schools for regular education programs.

In this report, Closest Types 2 refers to the above, except the numbers 2, 4, 6, 3 become 3, 6, 9, 3 respectively. (*i.e.* 3 top 25% schools, 6 top 50% schools, 9 top 75% schools, and 3 capacity schools.) See independent write up by Peng Shi for more on these plans (Shi 2013).

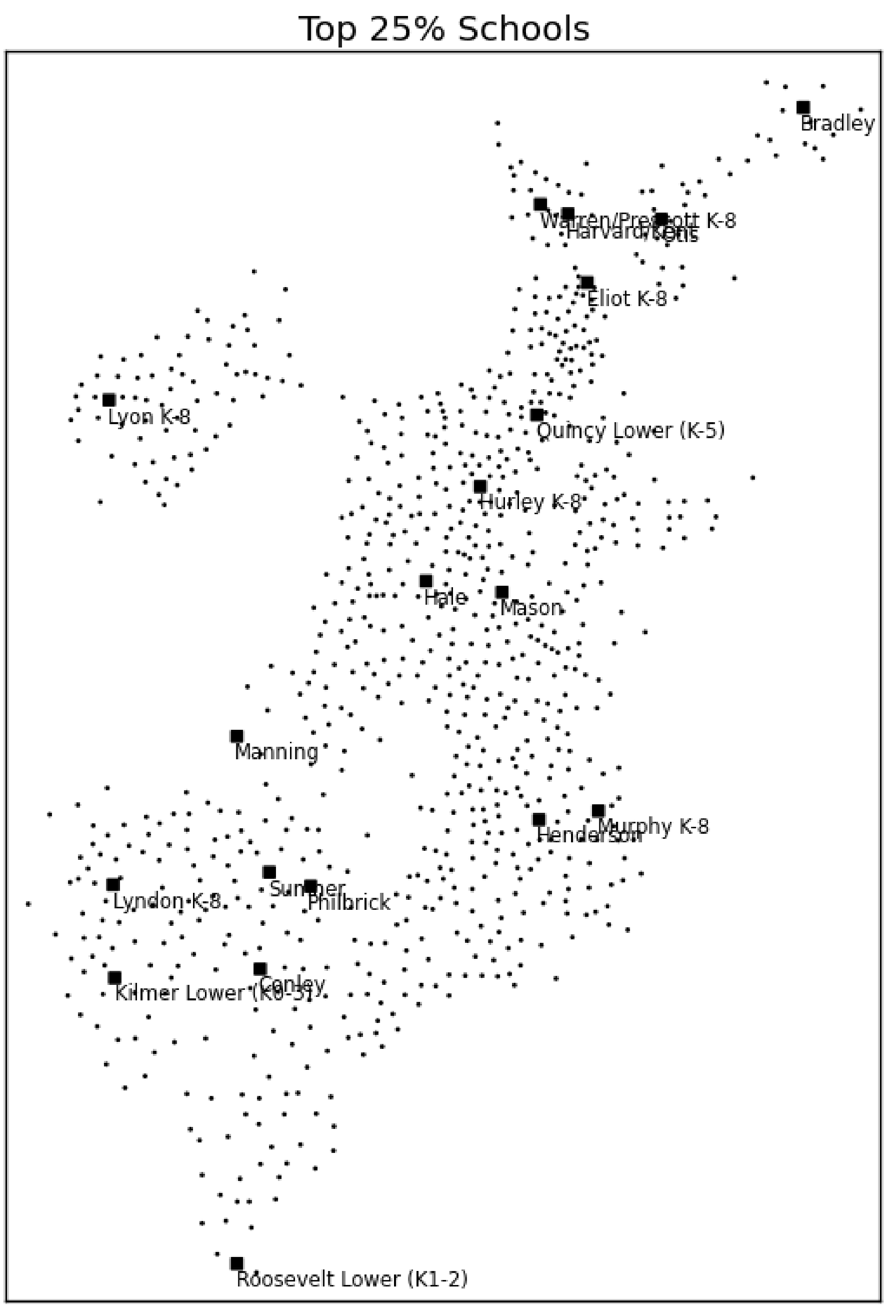


Figure 4: Top 25% schools by BPS MCAS Rank. Each family can choose from the closest 2 in Closest Types 1, and closest 3 in Closest Types 2.

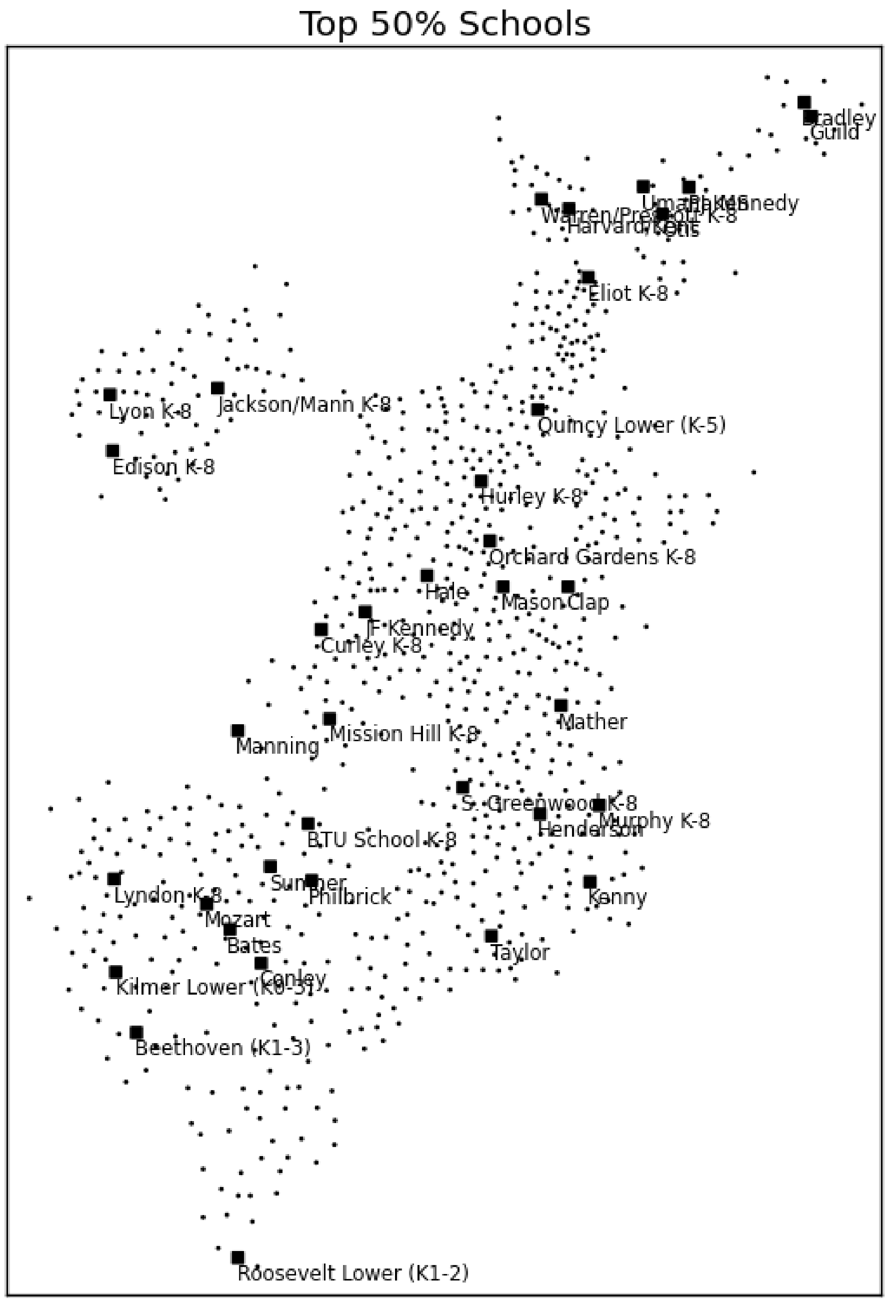


Figure 5: Top 50% schools by BPS MCAS Rank. Each family can choose from the closest 4 in Closest Types 1, and closest 6 in Closest Types 2.

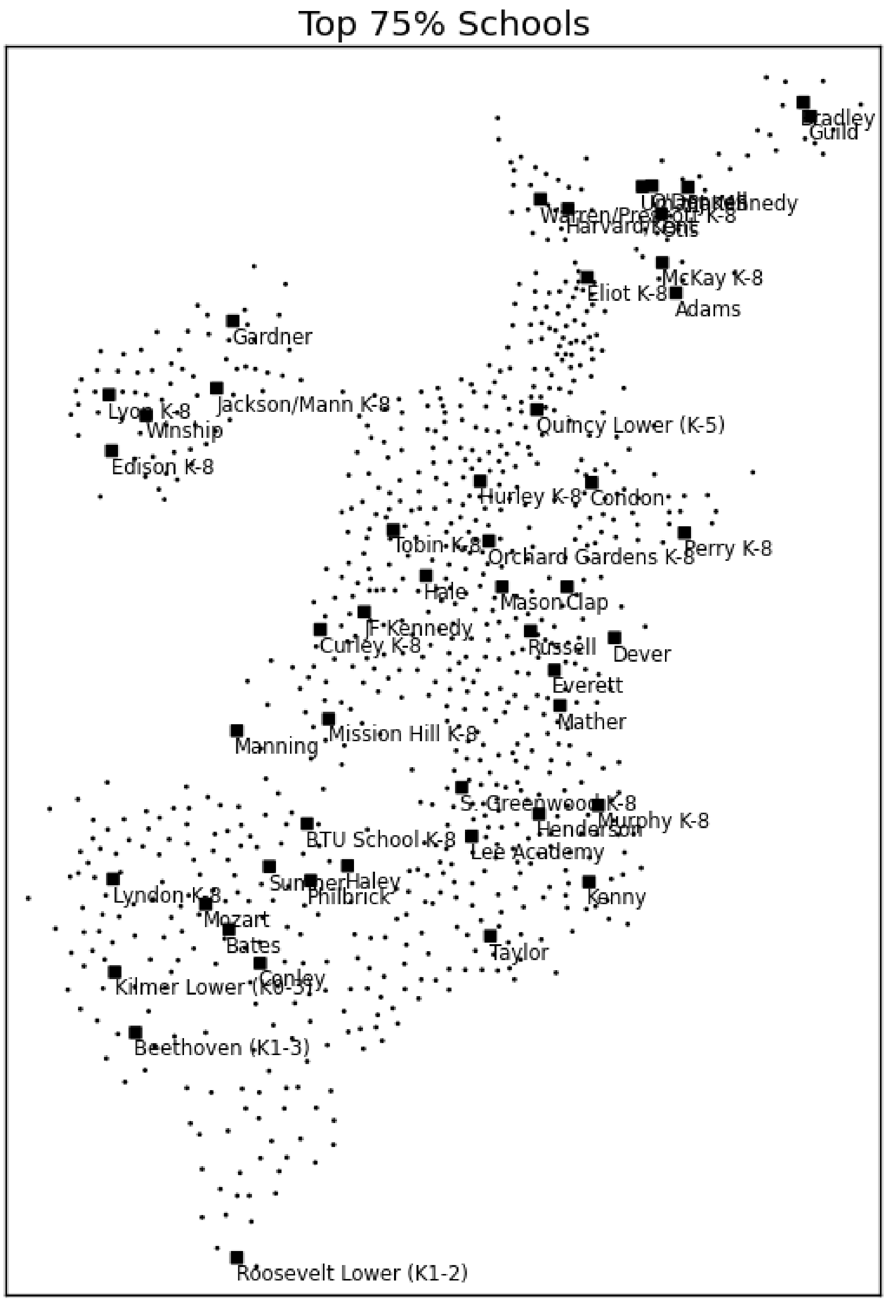


Figure 6: Top 75% schools by BPS MCAS Rank. Each family can choose from the closest 6 in Closest Types 1, and closest 9 in Closest Types 2.

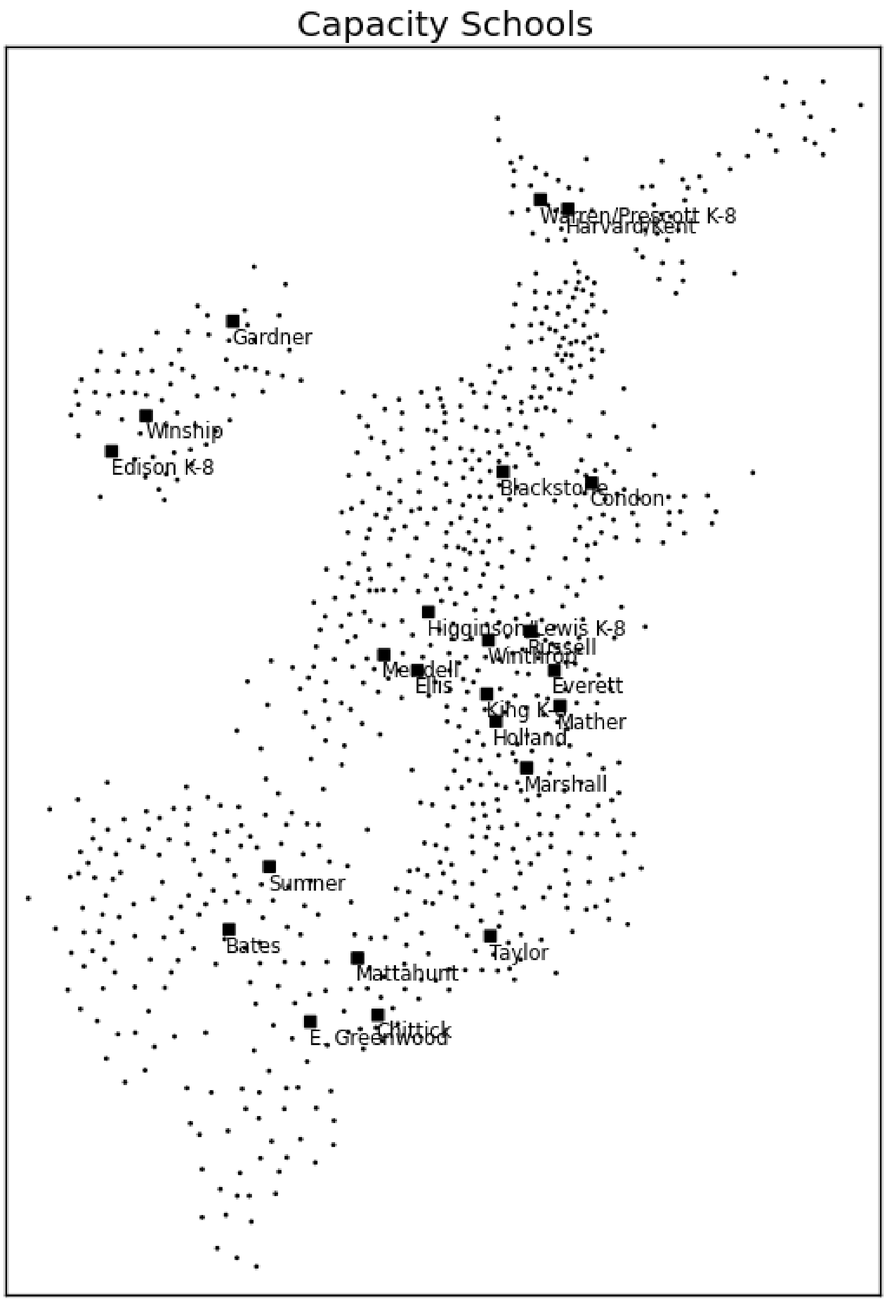


Figure 7: Capacity Schools estimated by Peng Shi. See Shi (2013) for methodology. BPS may alter these based on its long-term capacity plans. Each family can choose from the closest 3 capacity schools in both Closest Types models.

4 Evaluation Metrics

This section summarizes the definition of the metrics we use to compare assignment plans. These metrics were designed to provide a numerical value on some of the dimensions on which assignment plans can be evaluated.

4.1 Equitable Access to Academic Quality

As a proxy for school quality, we use the BPS MCAS rank. It is calculated as follows: using data for each school in 2011 and 2012 MCAS % Advanced/Proficient and Student Growth Percentile for Math and ELA ($2 \times 2 \times 2 = 8$ data points), weight performance levels 2/3 and growth 1/3, and compute a weighted average. Then rank all BPS elementary and middle schools by this weighted average to produce a relative rank where 100 is best and 0 is worst. The scores of all ranked K-8 entry points (schools with BPS Rank and kindergarten capacity) are shown in Table 2, which splits the schools into four tiers.

Tier 1	**Tier 2**	**Tier 3**	**Tier 4**
Bradley	Bates	Adams	Blackstone
Conley	Beethoven (K1-3)	Condon	Channing
Eliot K-8	BTU School K-8	Dever	Chittick
Hale	Clap	Everett	E. Greenwood
Harvard/Kent	Curley K-8	Gardner	Ellis
Henderson	Edison K-8	Haley	Grew
Hurley K-8	Guild	Lee Academy	Hennigan
Kilmer Lower (K0-3)	Hernandez K-8	McKay K-8	Higginson/Lewis K-8
Lyndon K-8	Jackson/Mann K-8	O'Donnell	Holland
Lyon K-8	JF Kennedy	Perry K-8	Holmes
Manning	Kenny	Russell	King K-8
Mason	Mather	Tobin K-8	Marshall
Murphy K-8	Mission Hill K-8	Winship	Mattahunt
Otis	Mozart		Mendell
Philbrick	Orchard Gardens K-8		Perkins
Quincy Lower (K-5)	PJ Kennedy		Trotter
Roosevelt Lower (K1-2)	S. Greenwood K-8		Tynan
Sumner	Taylor		Winthrop
Warren/Prescott K-8	Umana MS		Young Achievers K-8

Table 2: Schools tiered by BPS rank for K-8 entry points. The first column show the top 25% schools by MCAS; the second column shows the next 25%, and so on. In this report, a top 25% MCAS school is any school in the first column; a top 50% MCAS school is any school in the first 2 columns; a top 75% MCAS school is any school in first 3 columns. This data was computed and provided by BPS.

Given a plan and a quality threshold (*i.e.* top 25% MCAS), effective access to quality is defined as follows.

Definition 1 (Effective Access to Quality) *A student's effective access to quality is his/her chance of being assigned to a school considered "quality" that he/she also finds acceptable, if he/she ranks these schools ahead of all others, and everyone else's rankings stay fixed. (By assumption 2, "acceptable" means among his/her top 10 choices in menu.)*

For example, under the assumption of top 10 being acceptable, a student's *effective access to top 50% MCAS* is defined as follows: consider the student's top 10 choices in menu, identify the top 50% MCAS schools, and calculate his/her chance of getting into one of these schools if he/she reshuffled her choices to rank these schools first.

Note that Definition 1 is not the student's maximum opportunity to be assigned to a quality school. It represents the opportunity to be assigned to quality school that the student would also have ranked as one of their top 10 choices. For example, in the current system, in every zone there is some top 50% school with relatively low demand. While the marginal student in every zone could have changed their ranking to have high probability to go to a top 50% school, their *effective access to quality* may not be high, because the lower demanded "quality" school may not actually be among their top 10 choices.

Without the threshold of acceptability, the definition of access to quality would allow for a family to have quality access to a school even though though the family finds it unacceptable; the *effective* access to quality definition accounts for the preferences of families by including the proviso that a family would actually find the school *acceptable* (among their top 10 choices) based on their estimated demand.

However, it is worth highlighting two limitations of this definition of what is acceptable according to assumption 2 (top 10 choice in menu) because

- By offering families more choice options (that are not "quality"), it is possible to actually decrease their access to acceptable quality, because it makes their acceptability threshold higher. For example, a far-away good MCAS school may no longer be acceptable if a choice menu includes many nearby mediocre MCAS schools, simply because the family may have a strong preference for distance and the far-away good MCAS school is no longer among their top 10 choices.

- By removing choice options (that are not "quality") from a choice menu, it is possible to increase their access to quality, because their acceptability threshold is lowered when there are fewer choices. For example, a far-away good MCAS school that was not acceptable under a bigger menu may become acceptable if we remove some close-by schools from the menu.

It may be possible to interpret the notion of acceptability as affecting families' "attention" when we alter their choice menus. That is, a choice menu could change what is and what is not acceptable to participants. Our approach of treating the top 10 as acceptable is a crude behavioral approximation. Nevertheless, it incorporates the idea that quality only counts if it is acceptable to families and is logically consistent with our simulation methodology. Additional work modeling a student's outside options and examining how school offers translate to enrollment may provide another route to measuring what is acceptable; however, this is left for future work.

Having defined "effective access to quality" for every student, we examine whether a plan offers "equitable access to quality" by examining the effective access for the student who has the lowest value of effective access in the simulation. Since in every assignment plan, the number of quality seats remain the same, it is meaningful to compare how access is distributed rather than to compare the average across all students. Maximizing the access of the student with the lowest effective access to quality provides a measure of the *equity* of access.

4.2 Supply and Demand

Definition 2 (Effective Access to Capacity) *A student's chances of being assigned to an acceptable option. (By assumption 2, acceptable means among top 10 choices in menu.)*

This is equivalent to access to top 10 choice (defined in Section 4.4). Again, we constrain ourselves to providing a seat among the student's top 10 choices to capture that a family may not view the system as providing adequate capacity if it corresponds to an unacceptable option.

4.3 Access to Top Dream Choice

To evaluate the element of choice, we construct a metric that evaluates whether a plan

1. Gives families the choice options they most desire. (Not simply quantity of choice menu.)
2. Evaluates whether families have access to these choice options. (Not illusion of choice.)

With these considerations in mind, our metric is defined as:

Definition 3 (Access to Top k Dream Choice) *Suppose a family can rank any BPS program, including those outside of their choice menu, define what they would have chosen as top k to be their top k "dream choice." Given a plan, a family's access to top k dream choice is their maximum chance to get into one of their top k dream choices.*

It is worth emphasizing that this metric represent any choice in BPS, not those in a particular menu so that some dream choices may not be in a families' choice menu. This metric penalizes a plan if it does not offer families what they want (some dream choices not in menu), and also for not granting sufficient access to the dream choices, even if the families can rank them. The estimation of what the dream choices are for each applicant comes from the demand model.

4.4 Access to Top Menu Choice

We have two metrics for measuring access to top choices on a choice menu.

Definition 4 (Access to Top k Choice in Menu) *A student's chance of being assigned to one of the top k choices he/she chose.*

Definition 5 (Average Choice Number Obtained) *In an assignment run, we say that a student obtained choice number 1 if he/she got assigned to 1st choice. Similarly he/she obtained choice number 2 if he/she got assigned to 2nd choice, etc. The average choice number is the average choice number in 25 simulations. (We do not count toward the average if the student is unassigned. This measures the average conditional on the student being assigned.)*

4.5 Proximity to Home

A specific student's proximity to home depends on his/her specific choices (if he/she chooses a school far away, it will be large; if he/she chooses to stay near, it will be small). However, from the perspective of the simulation, students' preferences are random draws from our demand model, so we compute the "expected walk-distance" conditional on the student's observable characteristics. (*i.e.* the expected travel distance for a student who lives a particular neighborhood, with particular demographic attributes and siblings at particular schools.)

Definition 6 (Expected Walk-Distance) *A student's expected walk distance to school assignment, conditional on the student's observable characteristics and on being assigned. (The expectation is taken over realizations of random numbers and of random preference draws from the demand model.) Distance is measured using Google Maps Walk Distance.*

More precisely, for each plan, we input the simulated choices made by participants through the assignment algorithm to compute the simulated student assignment. We then estimate the walking distance from student's home to the assigned school using the Google Map Walk Distance between the centroid of the student's geocode to the centroid of the school's geocode. Because there are 868 geocodes throughout the city, a partition of the city by geocode partition provides a reasonable approximation. We then average 25 runs for each student, counting toward the average only instances when student is assigned. (Note that in each run, the simulated student preferences may differ because they are drawn from the distributions of preferences estimated by the demand model.)

Since we average distances across 25 simulations, it is possible there is a spread within students. For example, if half the times the student is assigned to a school 1 mile away and half the times she is assigned 5 miles away, although in real data we only observe either 1 or 5, our simulated average is $(1+5)/2 = 3$ miles.

4.6 Bus Coverage Area

To measure time on the bus and transportation costs, our measure of proximity to home may not be a good indicator. For example, if only a few students need to be transported far from home, a bus may still be required. The ideal metric would simulate multiple years of assignment and use routing software such as that used by BPS to actually compute an estimate of transportation costs. However, our simulation is based on one year's data and has no multi-year population and supply projection capacity, so we are unable to do this. For now, we focus on a much coarser measure.

A proxy to capture bus coverage area is the following:

Definition 7 (Average Bus Coverage Area) *For each school, its coverage area is the area in which a student living there can pick the school. The bus coverage area of a school is the coverage area outside of its walk zone (thus it is the maximum area a school needs to cover in planning its bus routes). The average bus coverage area is the average taken across all schools.*

In our calculations, we approximate the bus coverage area for each school by summing the areas of the geocodes that have access to the school, but are not in its walk zone.

4.7 Diversity

To compare racial and socioeconomic diversity across plans, we first define the following:

Definition 8 (Expected % Assigned Class of Demographic Group X) *In each simulation run, we look at the student's assigned class–same grade, same school, same program code–and calculate the proportion of those that belong to a demographic group X. (i.e. 40% of my class have free lunch status.) For each student, we average across the 25 simulation runs to arrive at an expected % assigned class of this demographic group. The average is taken over realizations of random numbers and draws from the preference distribution estimated from the demand model.*

For example, suppose we want to calculate the expected % assigned class free lunch. For a student, suppose in simulation 1 he/she is assigned to Kenny K-2 KED, and further suppose that 40% of students assigned to Kenny K-2 KED in that simulation are identified as having Free lunch status[6], we define his/her "% Assigned Class Free Lunch" in that simulation as 40%. The student's *expected* % assigned class free lunch is the average of this number across 25 simulations.

[6] One technical note is that the data file we were provided is missing lunch information for 36% of students, and we only count someone as free lunch if they are identified as free lunch and are coded as missing.

To measure socioeconomic diversity, we examine the "spread" of the expected % assigned class free lunch across students. If the spread is narrow–every one has roughly the same expected % of class Free lunch–then there is no difference across classes so the system is as diverse as possible under this metric. If the spread is large–some people have large % of classmates Free lunch, some have small %–then diversity is poor. To measure the "spread" we use the standard deviation from mean, where the standard deviation is taken across students. We also report plots of the whole distribution across models making it possible to visually see the distribution's range.

4.8 Community

One motivation for offering fewer choice options is that students may have higher chances to obtain a school offer with their neighbors. We quantify the magnitude of this aspect using the following metric.

Definition 9 (Same Grade Neighbor Co-Assignment Count) *Two students are "same grade neighbors" if they are of same grade and live within 0.5 miles walking distance from one another.*[7] *Two students are "co-assigned" if they are assigned to the same school. A student's "same grade neighbor co-assignment count" is the number of neighbors of same grade who are assigned to the same school as the student. We report the average across 25 simulations.*

This is a rough estimate, for example, of how many peers the student can expect to have to travel together to school.

5 Summary of Results

In this section we report some summary statistics which provide a high-level picture of the relative performance of the shortlisted plans with respect to various metrics. To be as informative as possible we focus the statistics on new families defined as those with no present school and no sibling within BPS. While the simulation takes into account everyone's choices and assignments, we focus on the results for new families for the following reasons:

1. Students who have present school have guarantee priority, and students with siblings have sibling priority. According to the demand model, a large majority will choose to go to their present school or where their sibling attends, and by their priority get in with high probability. Therefore, the assignments for continuing students and siblings varies little between assignment plans, and since almost half the data represent continuing students or siblings, including them does not provide a representative picture for new families (see Table 3 and Table 4).

2. We want to illustrate the effect of siblings and continuing students taking up capacity and decreasing access on other students. To identify this effect, we focus on those who are affected–new families.

3. The concept of "access" is predicated upon students choosing a certain set of schools as top choices. However, according to our demand model most continuing students and siblings rank their current school or school where a sibling attends first. Therefore it is more difficult to interpret what our notion of "access" means for them.

[7] We estimate walking distance between two students using the Google Map walk distance between the centroids of the geocodes where the students reside.

4. Our simulated results for continuing students and siblings are based on where their current present schools or sibling schools are, and this pattern may change after the new reform. But since our simulation is only for one year, we have no way of disentangling the residual effect of the old assignment plan and the new assignment plan for these students.

	Status Quo	10 Zone	Closest Types 1	Closest Types 2
% Ranking Present School Top 1	88.0%	90.2%	90.2%	89.2%
% Ranking Present School Top 2	96.8%	97.8%	97.9%	97.7%
% Ranking Present School Top 3	98.8%	99.3%	99.3%	99.2%
% Assigned to Present School	95.1%	96.2%	96.4%	96.2%

Table 3: Outlook for continuing students. Table reports how K2 continuing students chose and were assigned in our 25 simulation runs. The choices are based on the demand model, fitted using 2012-2013 actual choice data. A large majority of continuing students choose to remain in their present school, and succeed in doing so across the models.

	Status Quo	10 Zone	Closest Types 1	Closest Types 2
% Ranking Sibling School Top 1	59.1%	67.5%	67.9%	65.5%
% Ranking Sibling School Top 2	78.2%	82.4%	83.3%	81.8%
% Ranking Sibling School Top 3	86.3%	89.5%	90.1%	88.7%
% Assigned to Sibling School	76.9%	80.1%	81.2%	80.5%

Table 4: Outlook for Siblings. Table reports how K2 siblings (who are not continuing students) chose and were assigned in our 25 simulation runs. A large majority of siblings choose their sibling school first, and the vast majority choose as top 3 and obtain an offer.

5.1 Equitable Access to Academic Quality

Table 5 reports the metric for equity of access to quality according to our definition in Section 4.1. We focus on the Top 50% threshold based on Boston Public Schools recommendation. Readers interested in other thresholds of academic quality can refer to the Graph Appendix (Pathak and Shi 2013a).

MCAS	Status Quo	10-Zone	Closest Types 1	Closest Types 2
Top 50%	19.5%	22.6%	22.4%	25.5%

Table 5: Equity of Access to Quality. Effective Access to quality for the student with the lowest access to quality. For example, the above shows that in the simulated status quo, the student with the lowest access to quality has 19.5% chance to a school whose MCAS is top 50% and which the student would have ranked in their top 10.

It is important to emphasize that these represent numbers for the student with the **lowest** access to quality. In other words, according to this measure, every student has at least this much access to quality as the number in the table. It would, for instance, be a mistake to interpret these numbers as saying that a typical student only has a 19.5% percent chance of attending a high quality school in the status quo because this number represents the access for the student with the lowest access. Figure reports the distribution of effective access, with the red line representing the typical student, and shows the median is well above the lowest value.

Moreover, one must be cautious in judging relative merits of plans based on access to quality numbers alone. This is because roughly speaking, given a quality threshold,

$$\text{total access to quality} = \frac{\text{\# of quality seats}}{\text{\# of people ``competing'' for quality seats}}.$$

Since the total number of quality seats is fixed, the total access to quality in a plan is inversely proportional to the amount of competition for these quality seats. Hence, a plan could exhibit high numbers in Table 5 for two reasons:

1. It gives every student chance to select high performing schools. (Thus increasing equity.)

2. It reduces the competition for high performing schools. (Thus increasing overall access.)

If the quality metric (BPS tier) is a better indicator of quality than families' choices, then a choice plan should be evaluated by whether it allows families to select quality schools according to this metric. On the other hand, if families' choices are more reflective of underlying quality than our metric, then accommodating families choices rather than the quality metric is more important.

To understand whether the numbers in Table 5 are due to increasing equity or reduction of competition, we examine how the changes in choice menus in the plans affect families competition for quality. Table 6 tabulates the average # of "quality" schools families choose among their top 1, 3, 5, and 7 choices in various plans.

# Choices Quality in	Status Quo	10 Zone	Closest Types 1	Closest Types 2
Top 1 Choice	0.57	0.55	0.58	0.60
Top 3 Choices	1.64	1.60	1.68	1.75
Top 5 Choices	2.70	2.56	2.73	2.87
Top 7 Choices	3.77	3.41	3.75	3.97

Table 6: Number of Top 50% MCAS Schools in New Families' Top k choices. Table computes the average # of Top 50% MCAS schools that appear in K2 new families' top 1, 3, 5, and 7 choices, in different assignment plans. This measures roughly how much families are competing for "quality schools" in each plan. The higher the number, especially for top 1, 3, 5 choices, the more families are competing for quality seats in those plans.

Focusing on higher choices (top 1, 3, 5), we see the general pattern that families are competing less for quality seats (according to Top 50% threshold), in the 10-Zone plan than the Status Quo, and competing more for these seats in the Closest Types 1 plan and especially in the Closest Type 2 plan. This aligns with intuition because in the Closest Types plans schools with higher MCAS generally have larger coverage areas, so are offered to more families. Because higher competition for quality seats result in lower access for the marginal student, we expect the overall level of access to be lower in these plans. Figure 8 plots the distribution for effective access to top 50% MCAS, and illustrates that in general access for the non-zone plans is lower.

In sum, to use our access to quality metric to evaluate plans, one must first decide the following:

- Which quality threshold to examine (as the relative rankings may be different for different thresholds).

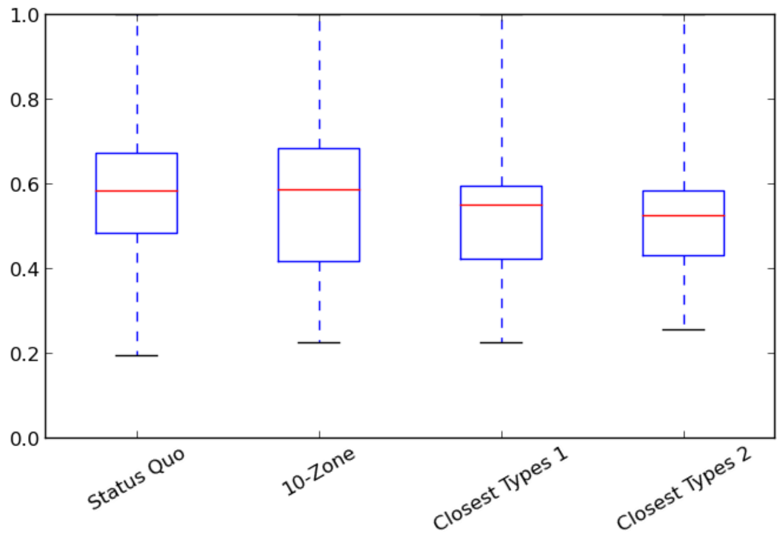


Figure 8: Effective Access to Top 50% MCAS for new families. The red line in each row shows the median, while the box shows the 25th and 75th percentile. The whiskers extend to the range of the distribution (worst-off and best-off student). Plans with higher levels of competition for quality seats (Closest Types) have lower general access, but having more families apply to quality seats may or may not be undesirable. For equitability, one can look at the length of the range (min-max) or box (25-75th percentile).

- Whether having more families apply to quality schools is desirable or undesirable. (On one hand, families are choosing quality schools; on the other hand, competition for quality schools becomes tougher.)

For this measure, it's also worth emphasizing that the important role played by our assumption that only the top 10 predicted choices are acceptable (Assumption 2) and the caveats in Section 2.

5.2 Supply and Demand

Table 7 plots Effective Access to Capacity for various plans. The apparent low figure in general is caused by a shortage of 341 school seats in 2012-2013 K2 Round 1. (Considering there are 1659 new families, and assuming siblings and continuing students all get assigned, this is a 21% shortage.) This is only a partial picture because seats can be added in later rounds, and more spaces may open up before the school year starts as some students who are assigned do not actually enroll. Furthermore, it's worth noting that we are only counting a school to be capacity for a family if it is within their top 10 choice (Assumption 2).

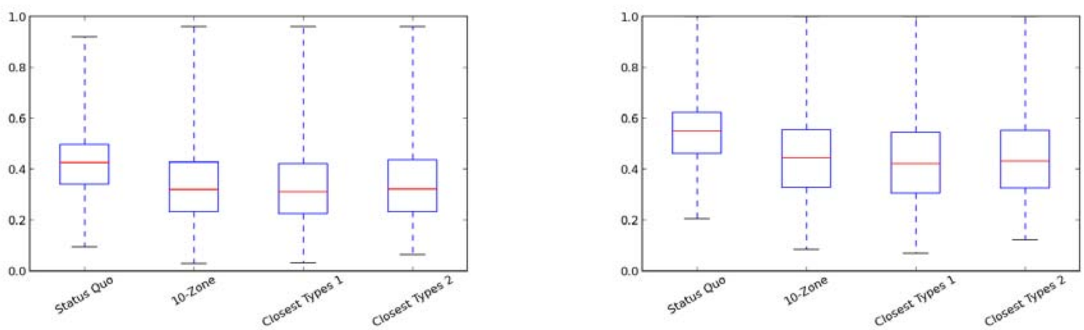
5.3 Access to Top Dream Choice

Smaller choice menus necessarily reduce the number of schools a student can rank. For some students, eliminating choices from the menu that they would not have ranked does not affect their assignment.

Percentile	Status Quo	10-Zone	Closest Types 1	Closest Types 2
0 (Minimum)	47.2%	31.4%	35.3%	34.9%
25	68.8%	66.1%	62.9%	61.4%
50 (Median)	81.9%	76.4%	70.5%	72.6%

Table 7: Distribution of Effective Access to Capacity. For example, the table shows that in the simulated status quo, every student has at least 47.2% access to some place in their top 10 choices.

However, there is significant heterogeneity in families' preferences, so removing an option that is unpopular in general for a neighborhood may still negatively affect families who may have liked that option. Figure 9 evaluates the element of choice in each plan, using access to top 3 and 5 dream choice (definition 3).



(a) Top 3 Dream Choice

(b) Top 5 Dream Choice

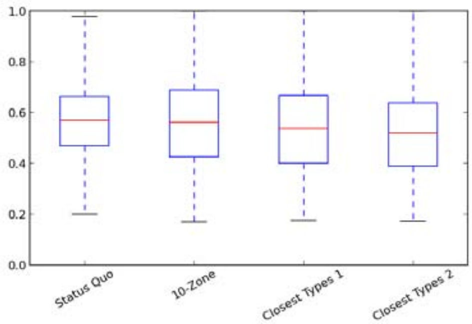
Figure 9: Access to Top 3 and 5 Dream Choice. The red line in each row shows the median, while the box shows the 25th and 75th percentile. The whiskers extend to the range of the distribution (worst-off and best-off student). The way to interpret is: the higher the red line is, the better is the element of choice for the representative student. The narrower the box is, or the higher the bottom line is, the more equitable is the element of choice.

As seen in Figure 9, all of the new plans decrease the element of choice compared to the status quo. However, this is to be expected because the choice menus in the new plans are significantly smaller.

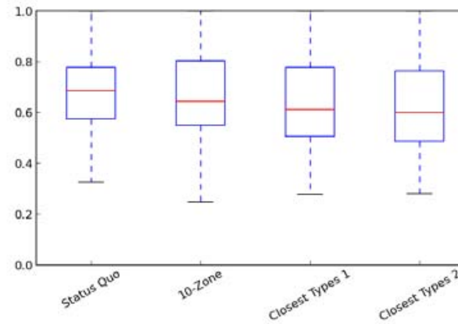
5.4 Access to Top Menu Choice

Figure 10 compares the distribution of Access to top 3 and 5 choice in menu (Definition 4), while Figure 11 compares the distribution of average choice number obtained (Definition 5).

In interpreting these figures, it may be helpful to revisit Table 4, which shows that smaller menus make more siblings more likely to rank a school where their sibling attends. This may decrease the access to top choices for new families since they have reduced chance of obtaining an offer at these schools. At the same time, a reduction in menu size decreases competition for some choices, and for the families who choose these first choices, access to top choices increases.



(a) Top 3 Choice



(b) Top 5 Choice

Figure 10: Access to Top 3 and 5 Choice in Menu. The red line in each row shows the median, while the box shows the 25th and 75th percentile. The whiskers extend to the range of the distribution (worst-off and best-off student). The way to interpret is: the higher the red line is, the better the top choice access for the representative student. The narrower the box is, or the higher the bottom line is, the more equitable the level of top choice access.

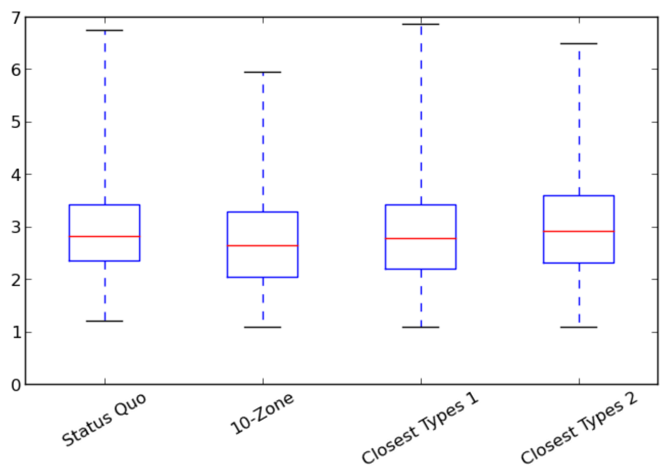


Figure 11: Average Choice Number Obtained. The red line in each row shows the median, while the box shows the 25th and 75th percentile. The whiskers extend to the range of the distribution. The smaller this is the more predictable.

As shown in both Figure 10 and Figure 11, compared to 10-Zone plan, the Closest Type models have slightly lower access to top choices for the median student. One way to understand this is to recall Table 6, in which we show that these models result in more students competing for “quality” seats. Because of the increased competition, students who select these as top choices will obtain decreased access to top choices.

5.5 Proximity to Home

Table 8 shows the average and median expected walk-distance to school in various plans (see Definition 6). Figure 12 compares the whole distribution. The distance to home in the new plans are all significantly smaller than the status quo.

Walk-Distance	Status Quo	10-Zone	Closest Types 1	Closest Types 2
Average	2.03	1.22	1.23	1.28
Median	1.87	1.12	1.15	1.19

Table 8: Expected Walk-Distance to School (in miles). The figures are calculated after computing an expected distance for each student from 25 simulations, then taking the average and median across the students.

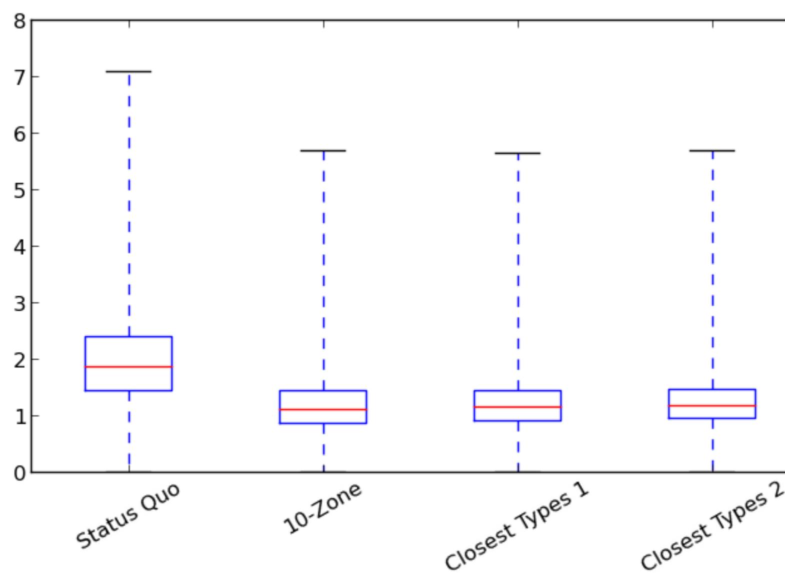


Figure 12: Distribution of Expected Walk-Distance to School (in miles). The red line shows the median. The box shows the 25th to 75th percentile. The upper line shows the maximum.

5.6 Bus Coverage Area

Table 9 tabulates the estimated average bus coverage area of each of the plans (see Definition 7), with and without the ELL overlay. As can be seen, all of the new plans significantly decrease the bus coverage area. Another observation is that having a separate geographic structure for the ELL-overlay incurs some costs in terms of extra bus coverage area. A harmonized Reg. Ed. and ELL geography seems likely to reduce costs.

	Current	10-Zone	Closest Types 1	Closest Types 2
Without ELL-Overlay	19.7	4.9	4.4	6.8
With ELL-Overlay	24.5	6.9	6.5	8.6
Cost of ELL-Overlay	4.8	2.0	2.1	1.7

Table 9: Estimated Average Bus Coverage Area. This table reports the average area from which a school may need to pick up children. (The school's access region outside its walk zone). The first line ignores the ELL-Overlay, while the second takes into account additional coverage area needed for schools with ELL programs.

5.7 Diversity

Figure 13 compares the distribution in terms of expected % Assigned Class Free Lunch.[8] As seen through the plot, there is not a dramatic difference between the status quo plots compared to the new plans. Some difference is to be expected because students are assigned closer to home and the city exhibits geographic variation in socioeconomic level.

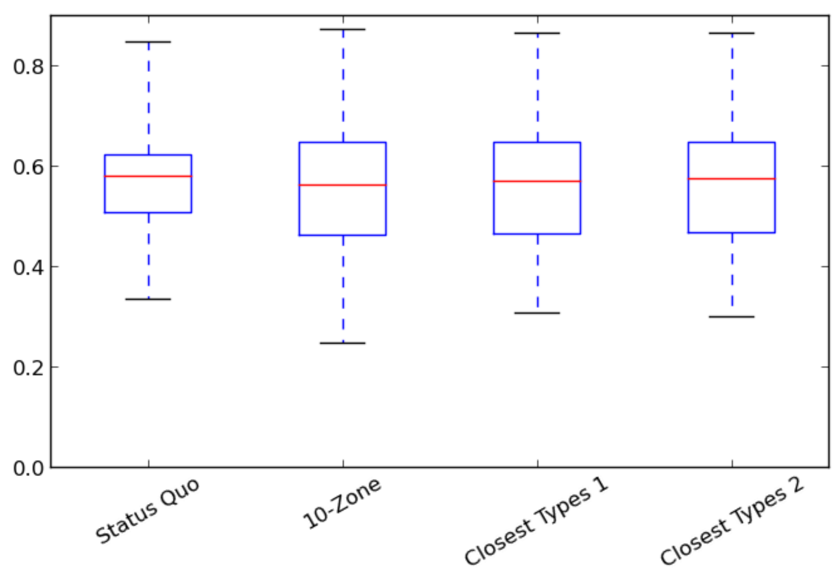


Figure 13: Expected % of Peers Free Lunch. The red line in each row shows the median, while the box shows the 25th and 75th percentile. The whiskers extend to the range of the distribution (worst-off and best-off student). The way to interpret is: narrower the rectangle is, or the narrower the range is, the more diverse.

Table 10 tabulates the across student variation in % Assigned Class Free Lunch. This is computed

[8]Note that we are missing lunch information for 30% of non-continuing K2 students, and in this calculation we are only counting those who are explicitly noted as receiving free lunch, while keeping the denominator the size of the whole class.

as the standard deviation across students. This single number captures the "spread" of % Peers Free Lunch, and therefore represent a measure where a lower number means lower standard deviation across schools.

	Current	10-Zone	Closest Types 1	Closest Types 2
Standard Deviation	9.0%	11.3%	11.2%	11.1%

Table 10: Standard Deviation in % Classmates Free Lunch. A lower number corresponds to more socioeconomic diversity.

For racial diversity, we tabulate the cross-sectional variation of % Assigned Class of a certain race in Table 11. It is important to emphasize that this metric does not represent the fraction of students of a particular race in a class, but rather the spread in this fraction.

	Current	10-Zone	Closest Types 1	Closest Types 2
Black	14.1%	15.4%	15.5%	15.4%
White	9.4%	12.2%	11.2%	11.1%
Hispanic	17.7%	19.2%	18.4%	18.2%
Asian	9.0%	10.0%	10.3%	10.3%

Table 11: Standard Deviation in % Classmates of certain race. A lower number corresponds to more racial diversity.

The statistics in both Table 10 and 11 show that the new plans result in a modest decrease in diversity relative to the current plan.

5.8 Community

Table 12 shows the distribution of Same Grade Neighbor Co-Assignment Count in various plans. (# of others living within 0.5 miles walking distance from applicant of same grade assigned to same school). A higher number represents greater community cohesion.

	Current	10-Zone	Closest Types 1	Closest Types 2
25 Percentile	1.68	2.16	2.24	2.20
Median	3.12	3.88	4.04	3.92
75 Percentile	5.28	6.20	6.40	6.10
Average	3.93	4.87	4.75	4.57

Table 12: Same Grade Neighbor Co-Assignment Count. (The # of neighbors I can expect to go to same school with within my grade.) A higher number represents greater community cohesion.

As can be seen, plans with smaller choice menus, which are closer to home, in general tend to concentrate assignments on fewer schools, and therefore improve co-neighbor count. Note that all of the new plans improve community cohesion over the status quo. It is also worth emphasizing that this counts the number of applicants who participate in the first Round of the application grade and are assigned to the same program and does not include students in subsequent rounds or grades at the school.

6 Details by Plan

This section reports on maps and graphs for each evaluated plan as follows.

- Map of Effective Access to Top 50% MCAS. (Equitable Access to Quality)
- Breakdown of Access to Top 50% MCAS by Race, Lunch Status, English Proficiency Status, and Neighborhood. (Equitable Access to Quality)
- Map of Average Choice Number Obtained. (Access to Top Menu Choice)
- Map of Expected % Classmates Free Lunch. (Socioeconomic Diversity)

All of the graphs shown here report numbers for new families, even though the effect of siblings and continuing students are taken into full account in the simulation. When a breakdown is reported by demographic group or neighborhood, it corresponds to the values computed for applicants historically. Please refer to Table 1 for details on the number of students represented when results are reported for demographic groups or neighborhoods. In some cases, especially for the neighborhood breakdown, the splits represent only a small number of students who are represented.

The Graph Appendix contains additional material for interested readers.

6.1 Status Quo

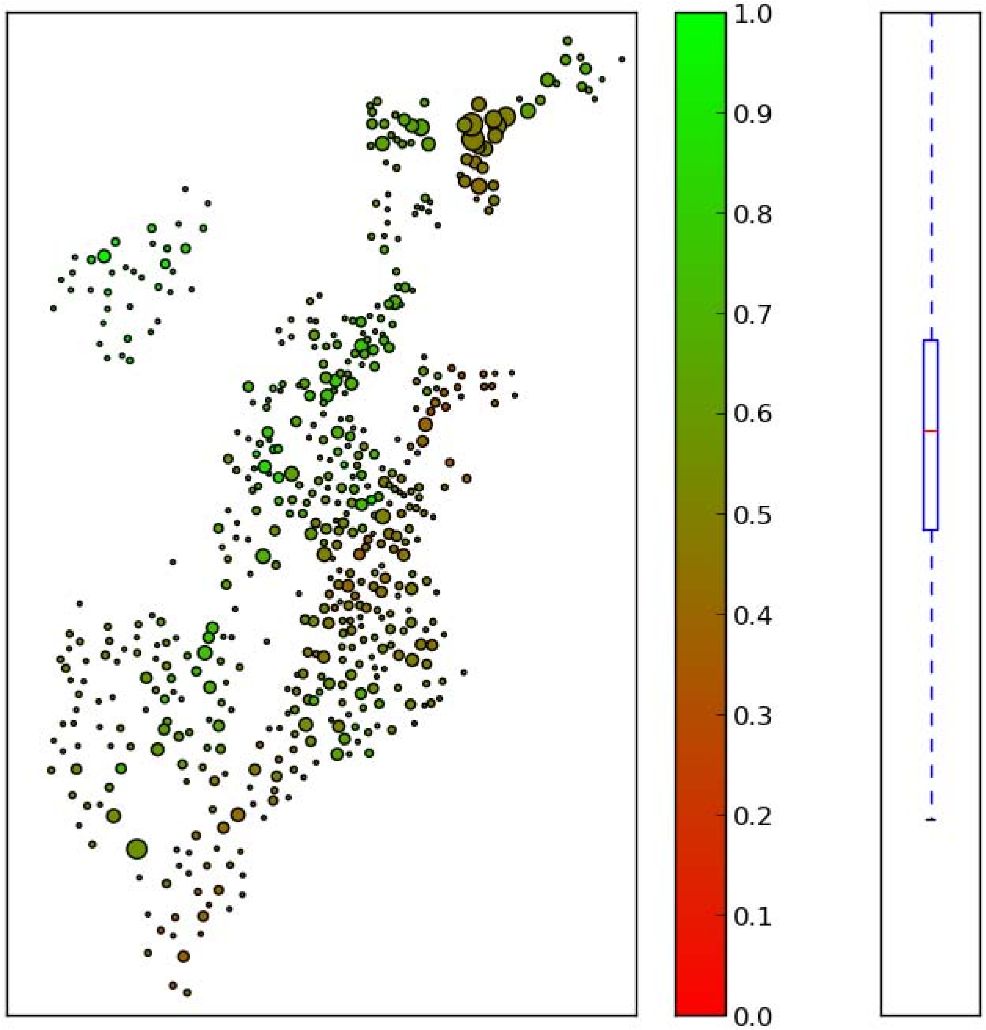
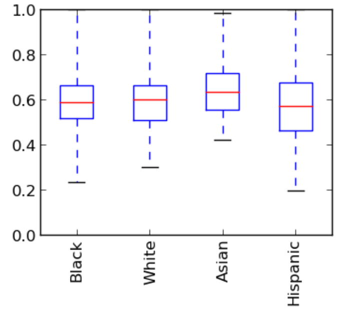
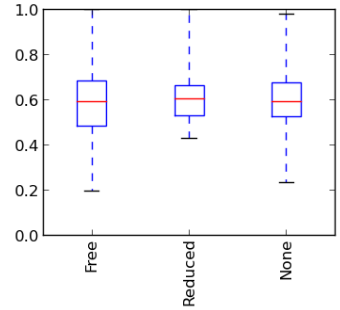


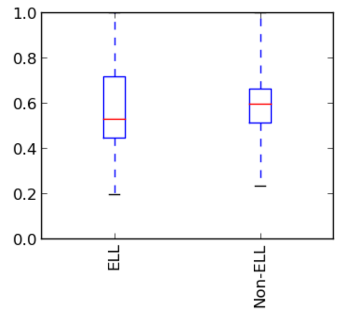
Figure 14: Effective Access to Top 50% MCAS in Status Quo



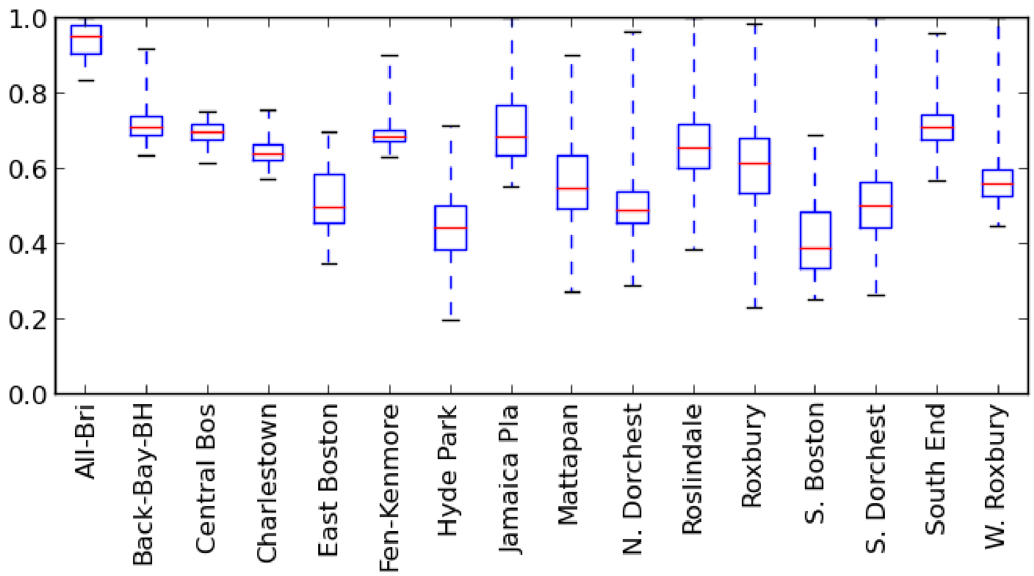
(a) By Race



(b) By Lunch Status



(c) By English Proficiency Status



(d) By Neighborhood

Figure 15: Breakdown of Effective Access to Top 50% MCAS in Status Quo.

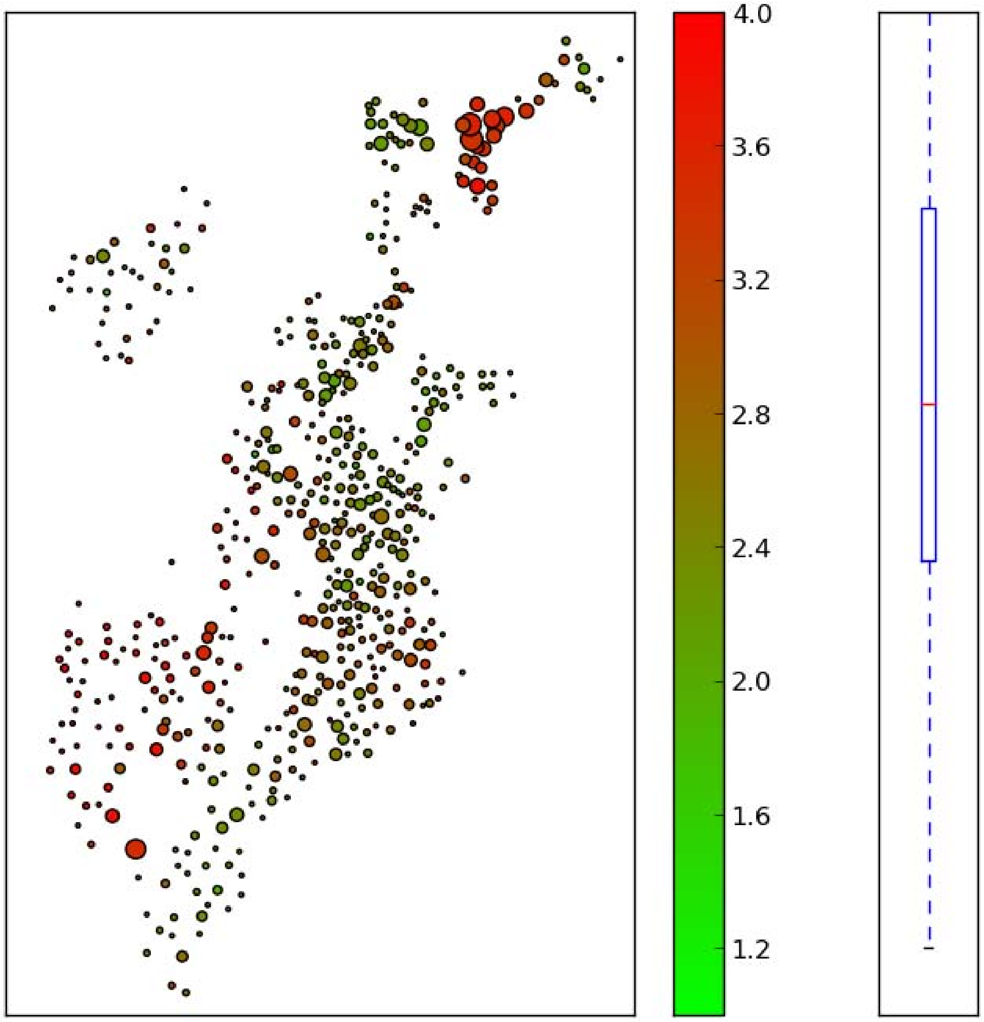


Figure 16: Average Choice Number Obtained in Status Quo

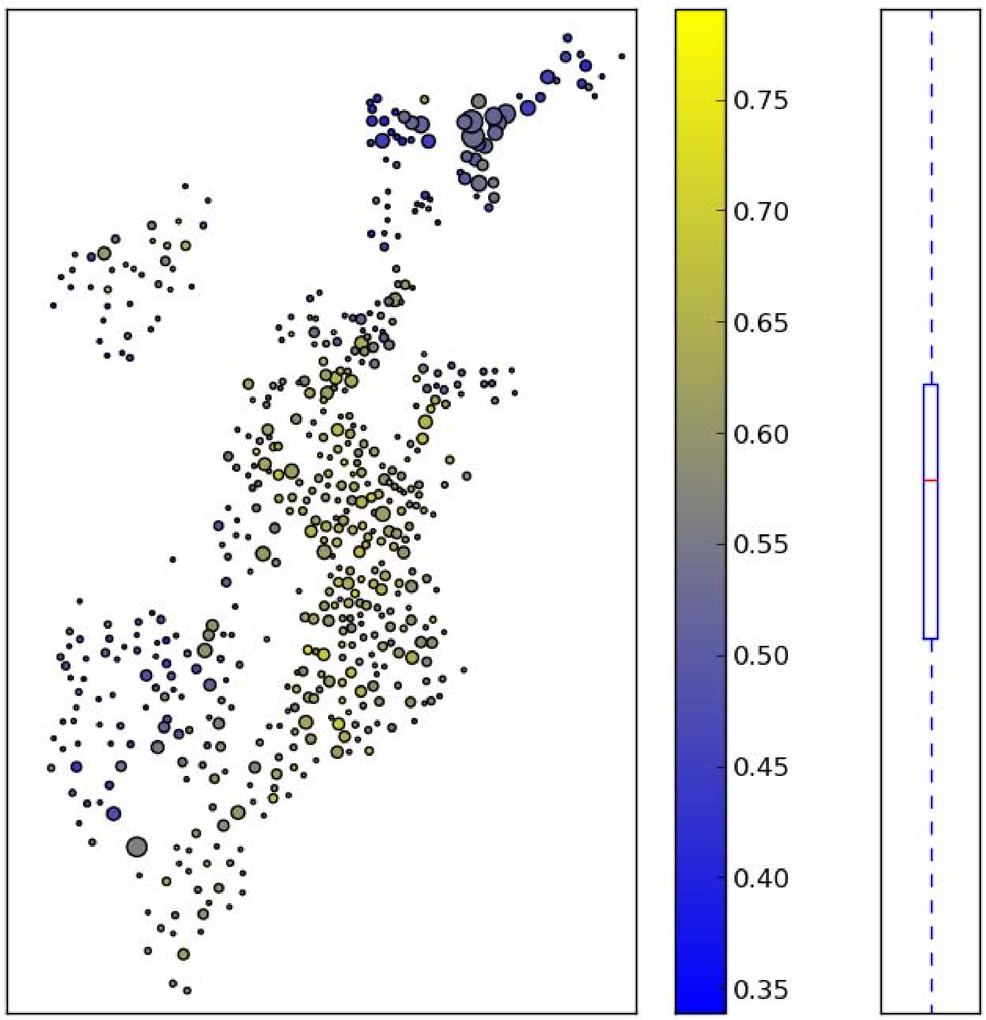


Figure 17: % of Assigned Class with Free Lunch Status in Status Quo

6.2 10-Zone

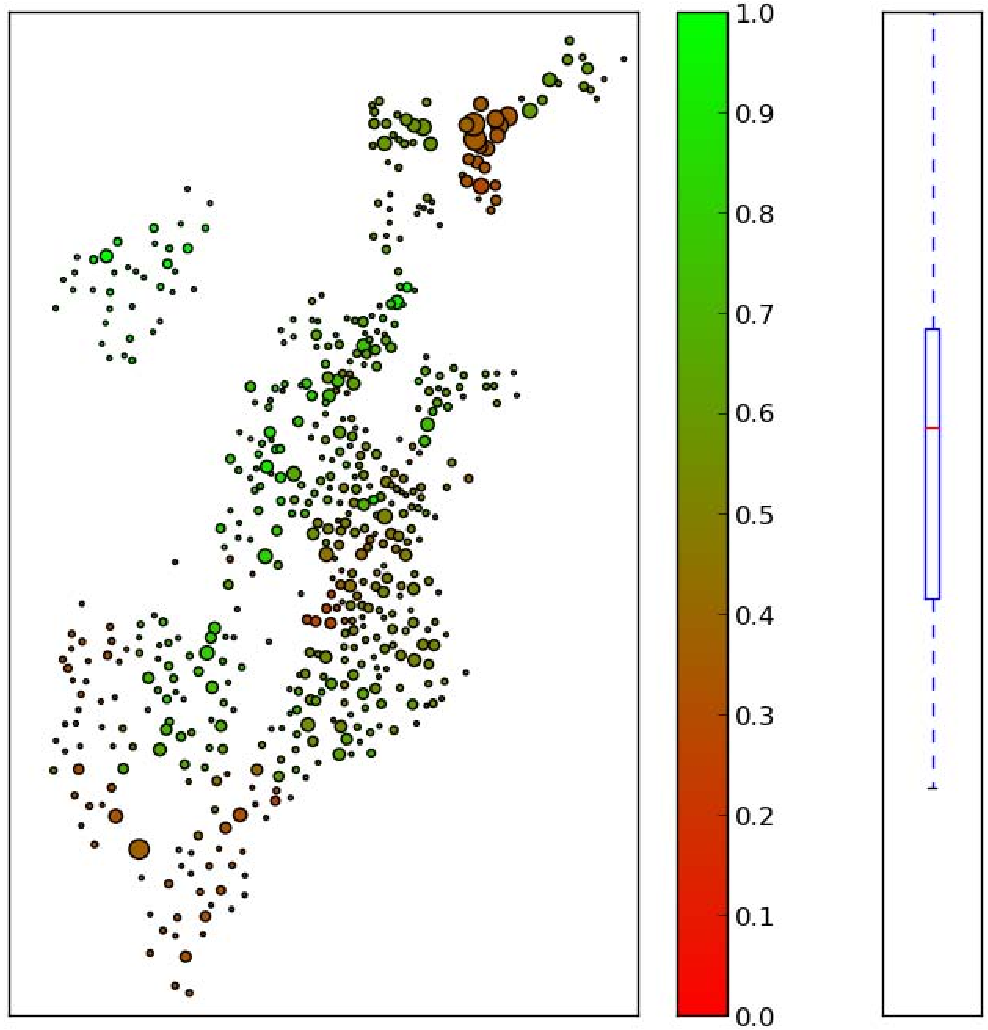
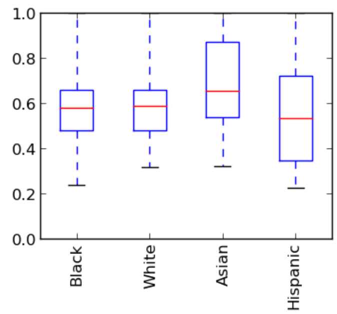
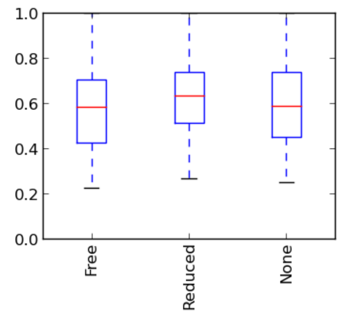


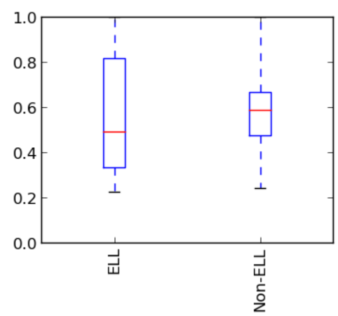
Figure 18: Effective Access to Top 50% MCAS in 10-Zone



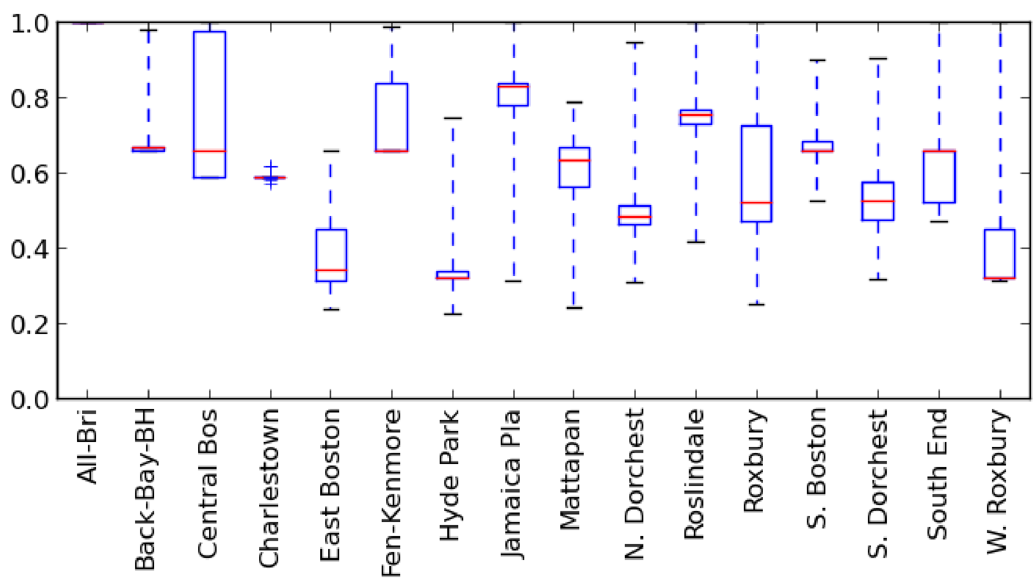
(a) By Race



(b) By Lunch Status



(c) By English Proficiency Status



(d) By Neighborhood

Figure 19: Breakdown of Effective Access to Top 50% MCAS in New 10-Zone.

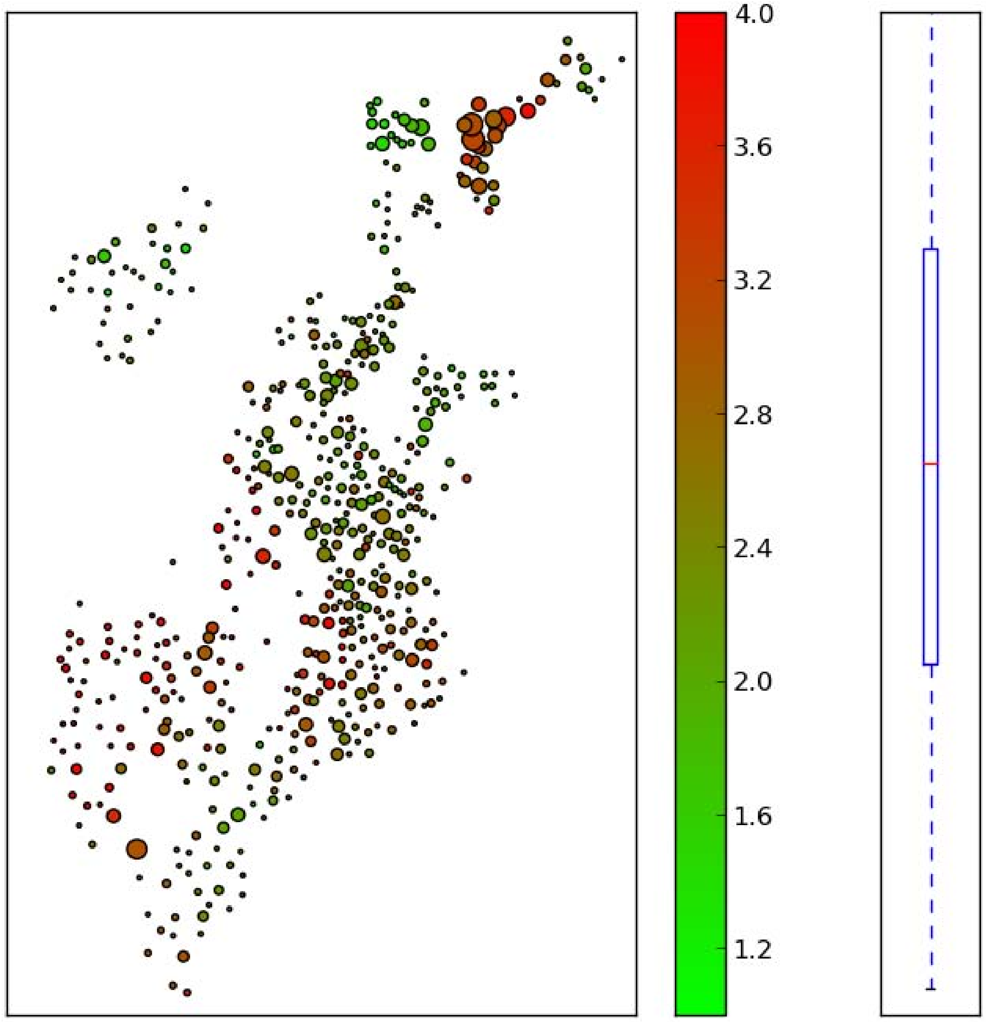


Figure 20: Average Choice Number Obtained in New 10-Zone

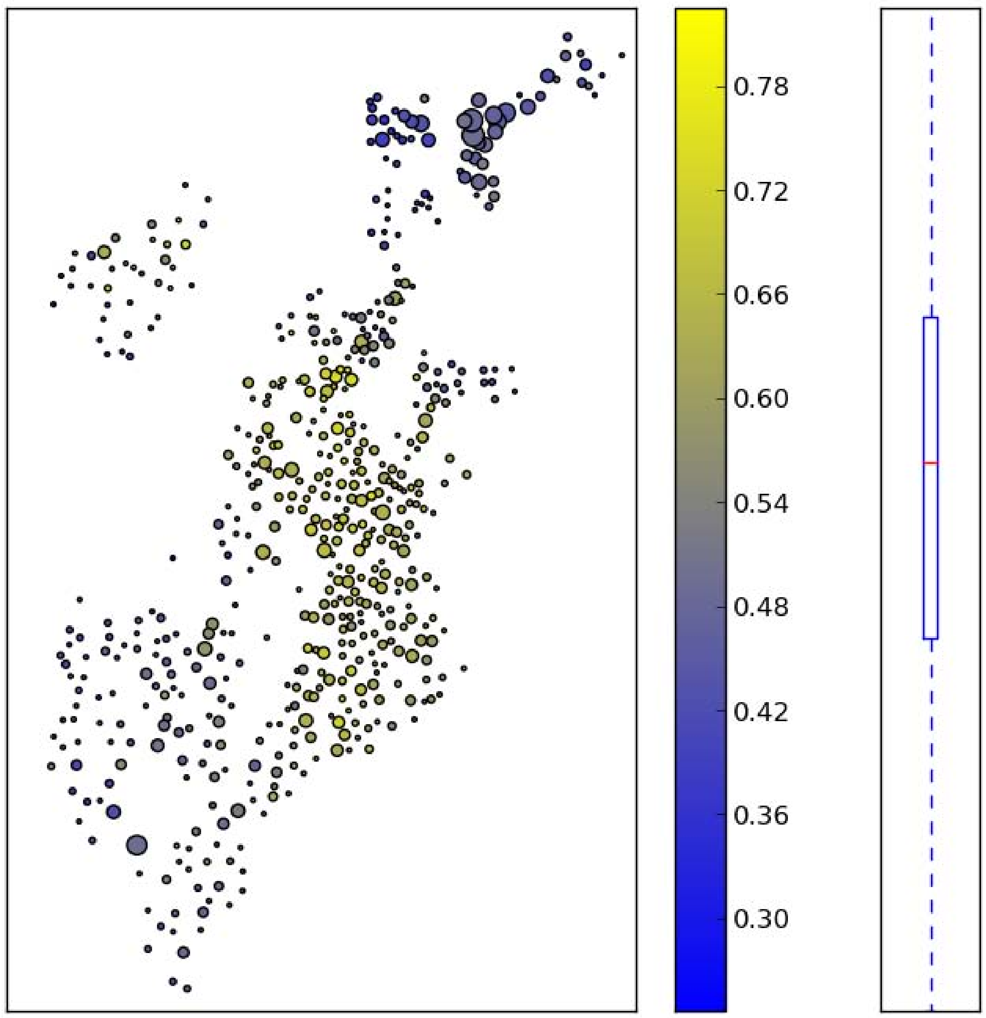


Figure 21: % of Assigned Class with Free Lunch Status in New 10-Zone

6.3 Closest Types 1

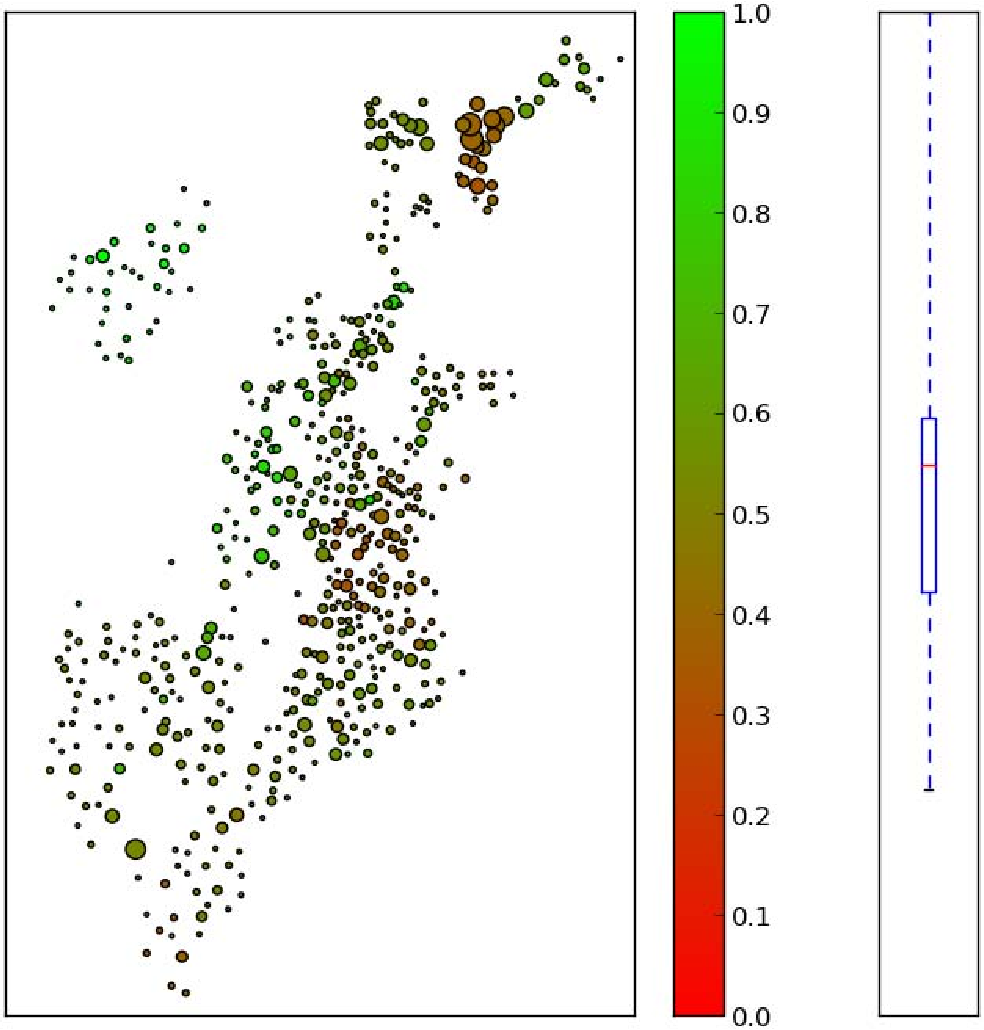
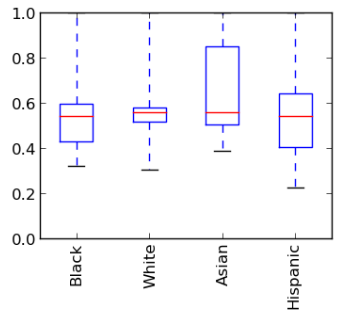
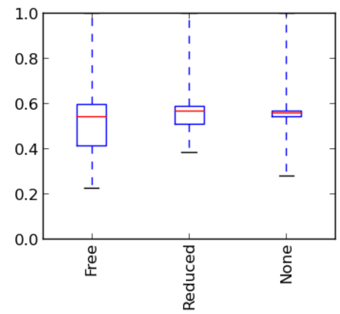


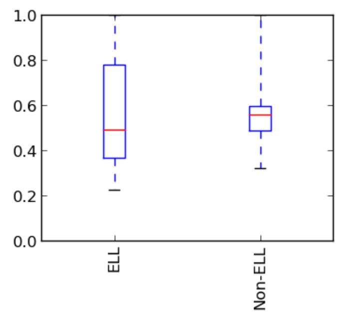
Figure 22: Effective Access to Top 50% MCAS in Closest Types 1



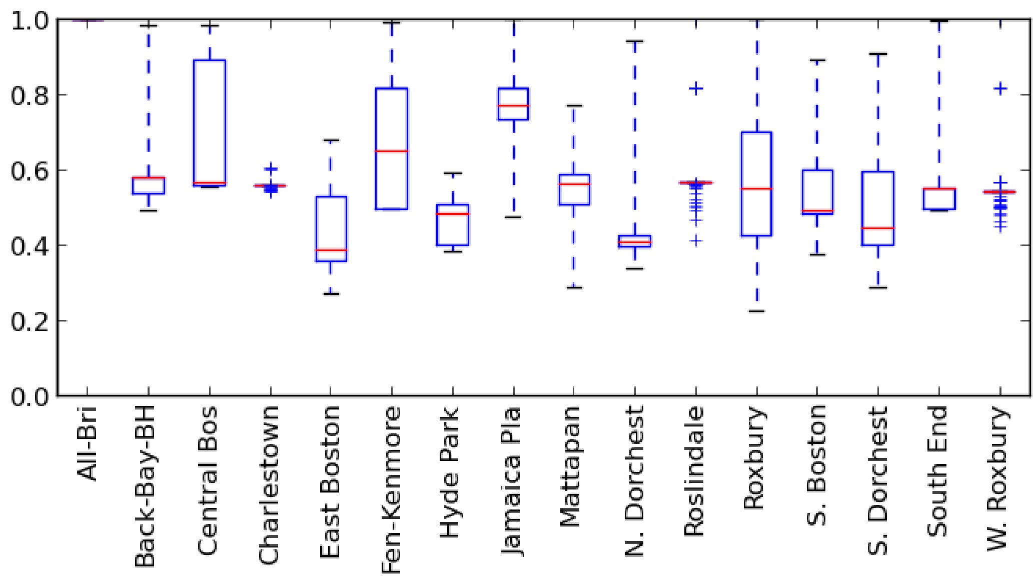
(a) By Race



(b) By Lunch Status



(c) By English Proficiency Status



(d) By Neighborhood

Figure 23: Breakdown of Effective Access to Top 50% MCAS in Closest Types 1.

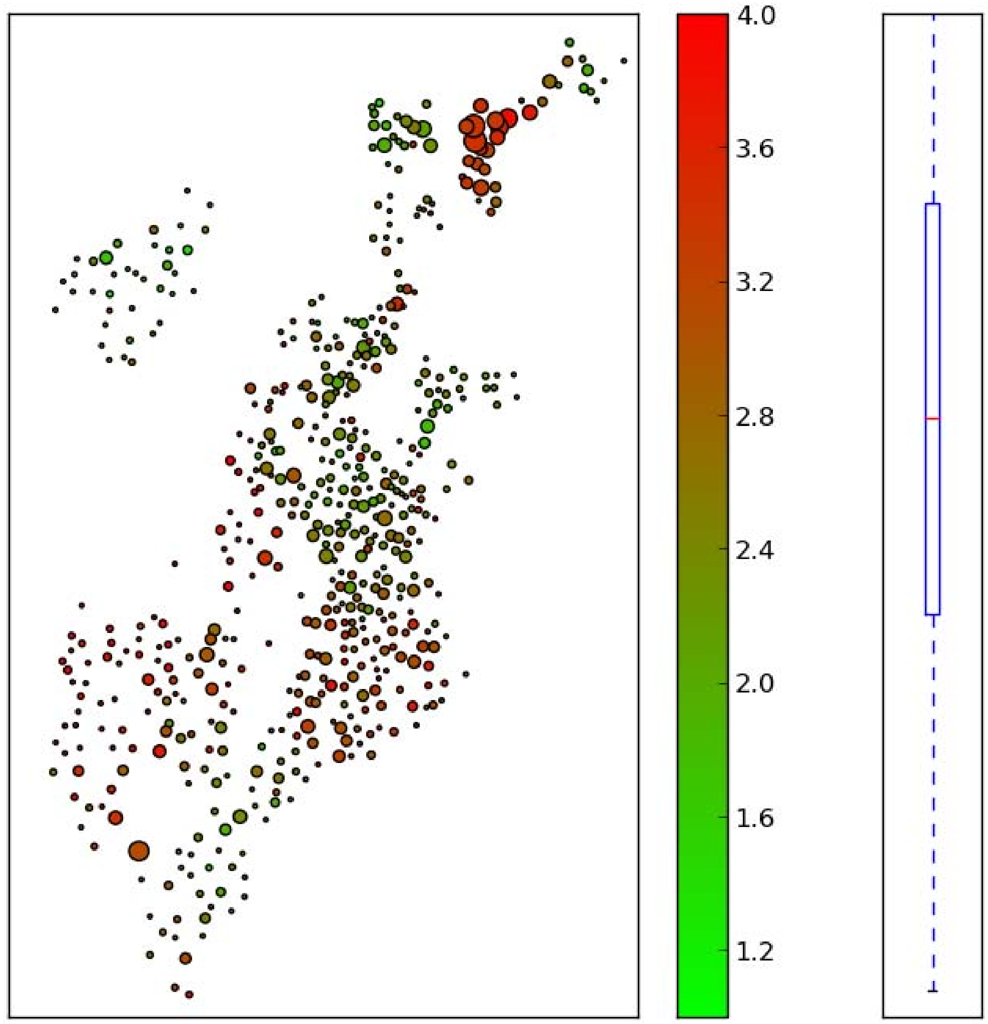


Figure 24: Average Choice Number Obtained in Closest Types 1

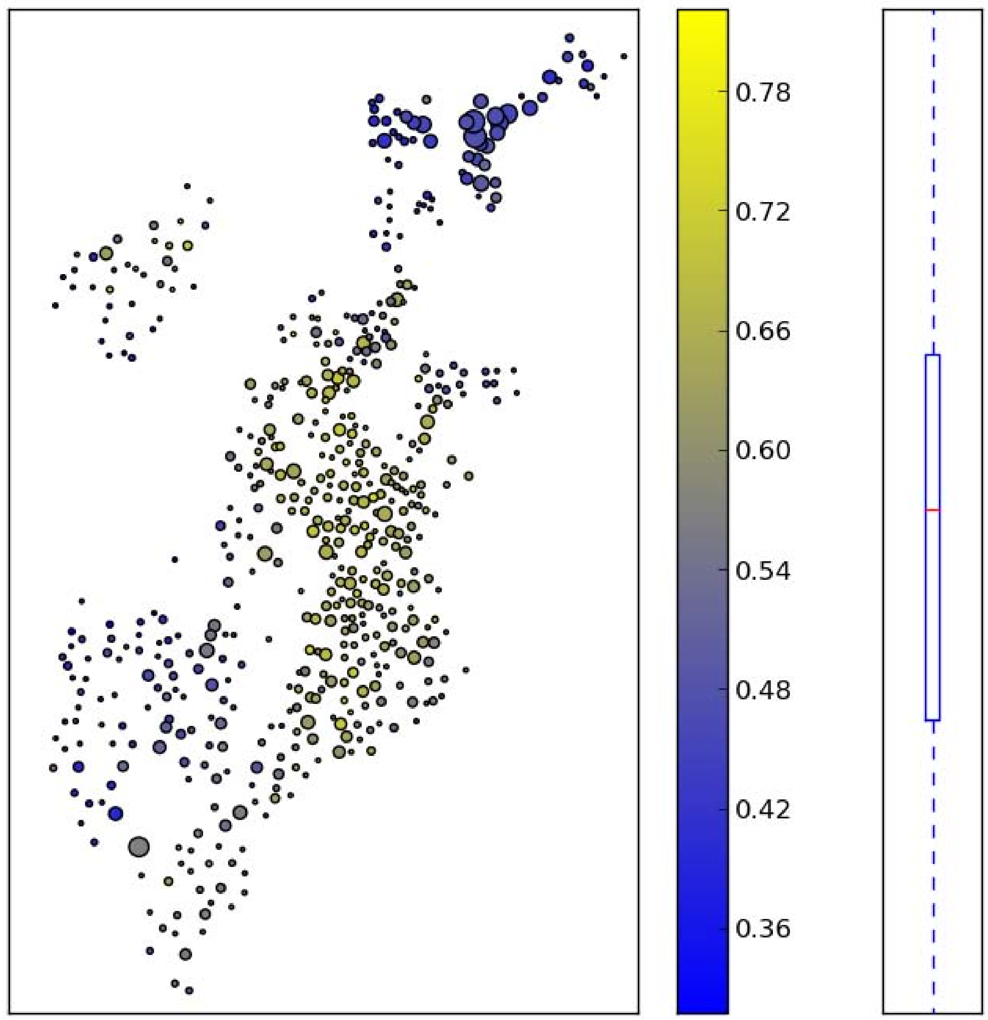


Figure 25: % of Assigned Class with Free Lunch Status in Closest Types 1

6.4 Closest Types 2

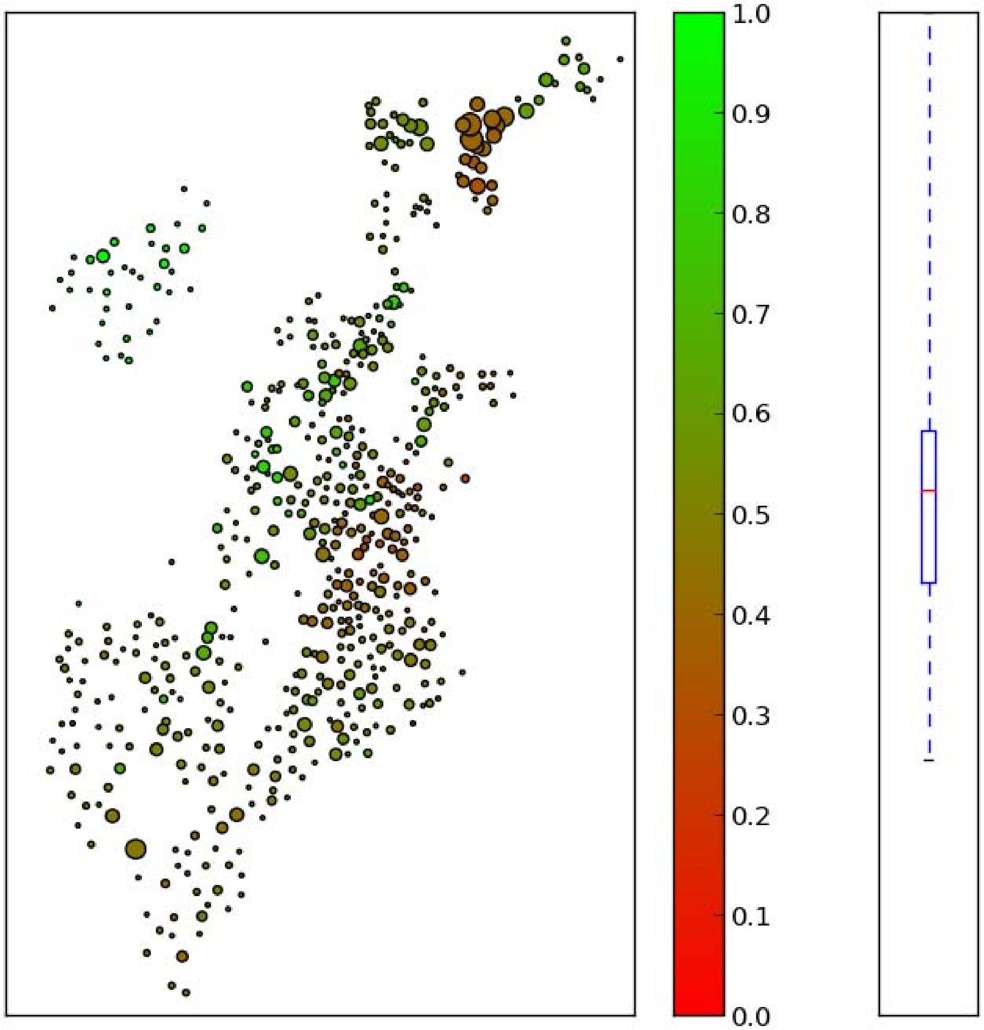
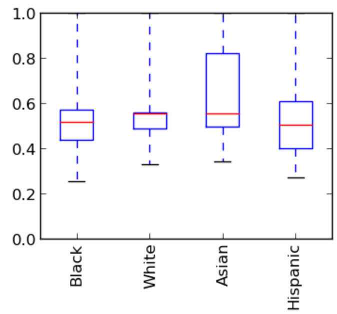
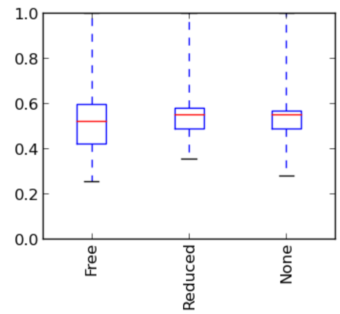


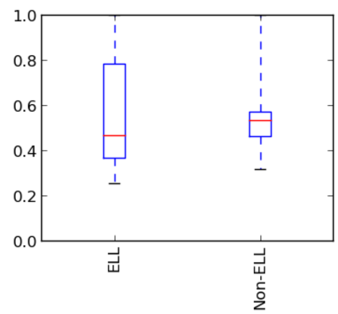
Figure 26: Effective Access to Top 50% MCAS in Closest Types 2



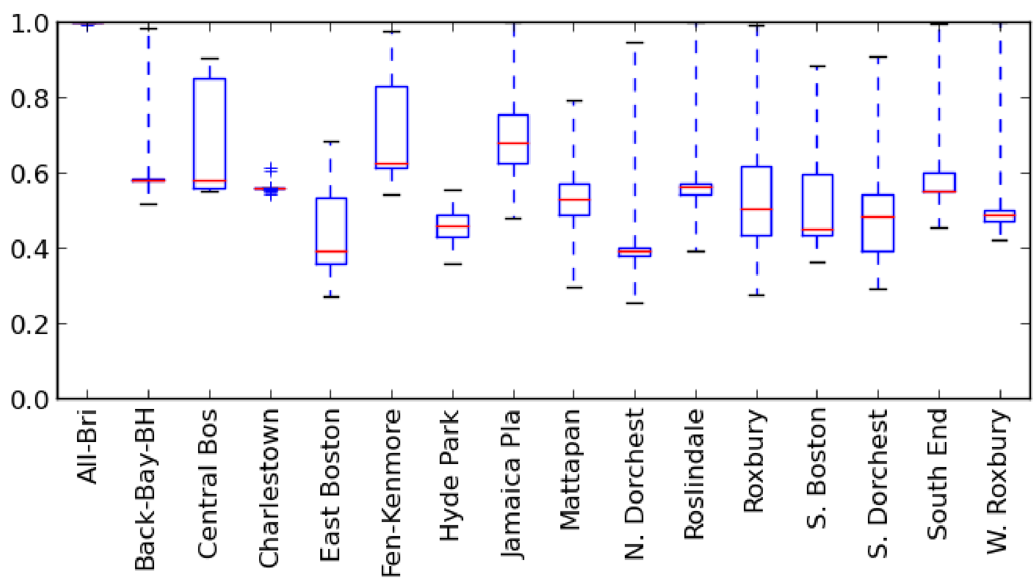
(a) By Race



(b) By Lunch Status



(c) By English Proficiency Status



(d) By Neighborhood

Figure 27: Breakdown of Effective Access to Top 50% MCAS in Closest Types 2.

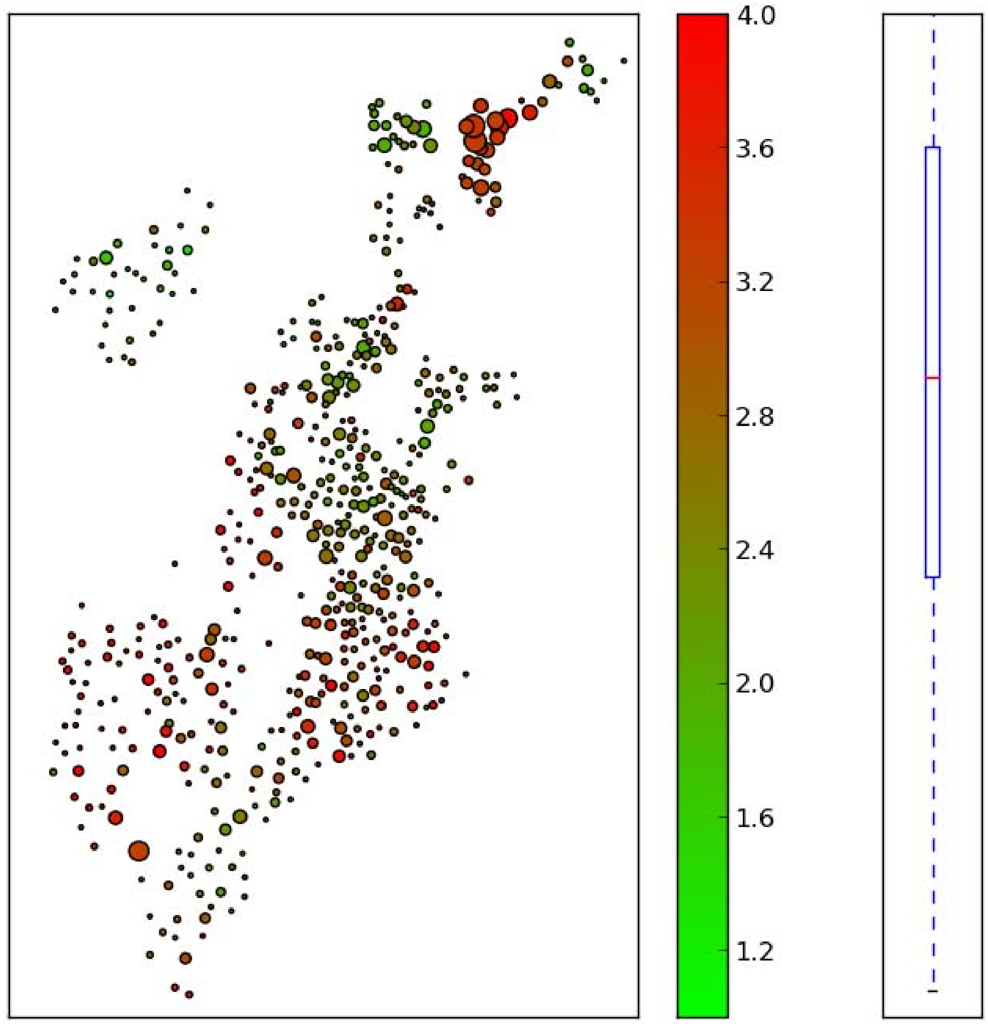


Figure 28: Average Choice Number Obtained in Closest Types 2

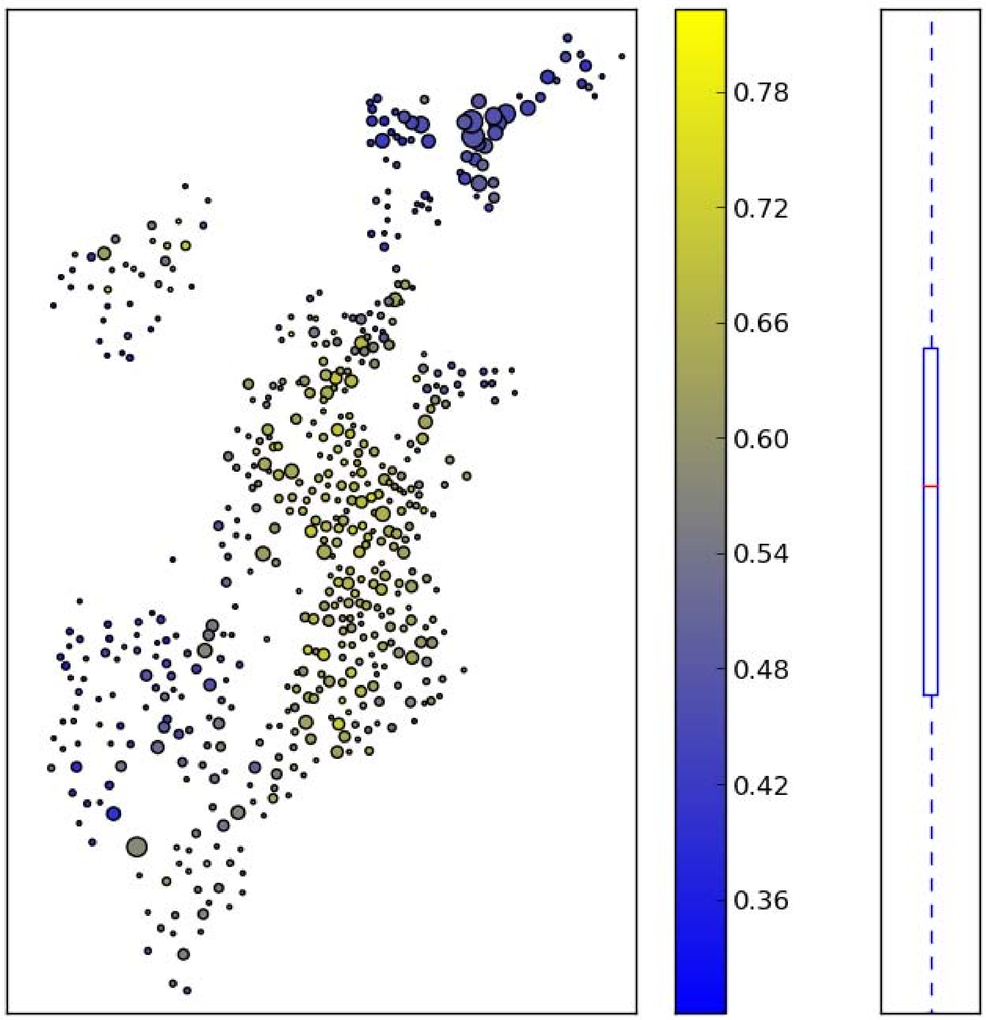


Figure 29: % of Assigned Class with Free Lunch Status in Closest Types 2

7 Analysis on Walk-Zone Set Aside

In addition to changing choice menus, another policy lever is to alter how priorities are processed in the assignment algorithm. At most Boston schools, there is a 50% walk zone set-aside, which prioritizes students applying from within the walk zone. In the algorithm, students have the opportunity to apply to both school halves: the walk zone half and the open-half. Recently BPS recommended considering a change the processing order of these seats:[9]

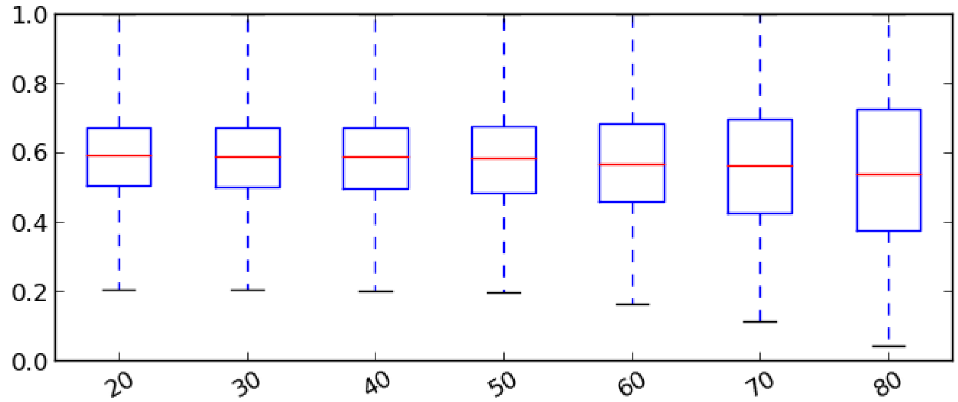
- **Old Processing Order:** students from within the walk zone apply to the walk-half first; students from outside apply to the open-half first.
- **New Processing Order:** the open half is divided into a first open "quarter" and a second open "quarter." All students, regardless of walk zone status, apply first to the first open quarter, then to the walk-half, then to the second open quarter. (This processing order has described as the "compromise" order)

All of this may significantly affect the relative access of students from inside and outside the walk zone. In this section, we report for each plan the effect on access to quality, predictability, and proximity, by changing the walk zone set-aside. For current 3-Zone, we show both the old and new processing order. For the new models, we only show the new processing order. All of the statistics are for K2 new families.

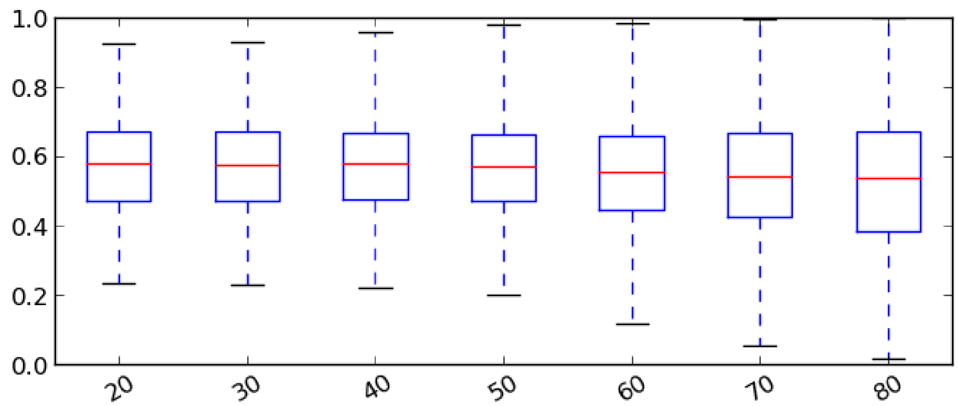
Roughly speaking, the general pattern is:

- The old processing order only shows shows aggregate effects at some point around or above 50% walk set-side. In other words, because open competition by itself fills most schools with 50% walkers, walk zone priority does not have an effect until that point.
- The new processing order seems sensitive to set-aside increases at all levels.
- When the walk set-aside increases, equity of access to quality tends to decrease, predictability tends to decrease for some and increase for some (so the spread is increased), and distance to home tends to decrease.
- For the same set aside, the new processing order gives more advantage to walkers than non-walkers. Roughly speaking, with the same set-aside, going from old to new processing order, equity of access to quality decreases, predictability shows little general pattern, and distance to home decreases.

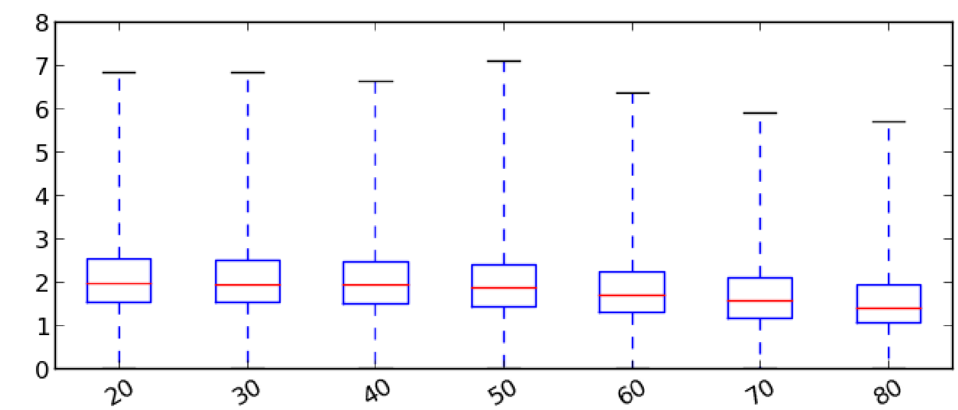
[9] For details on the theory of processing orders, see Dur, Kominers, Pathak, and Sönmez (2012).



(a) Effective Access to Top 50% MCAS

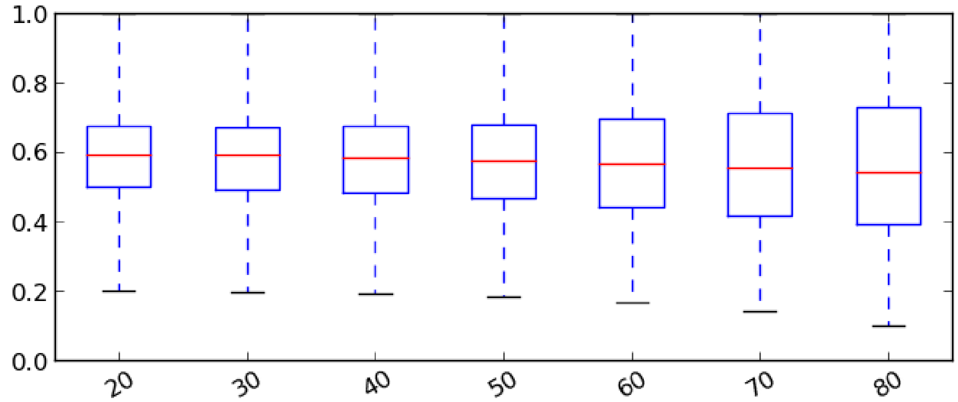


(b) Access to Top 3 choice

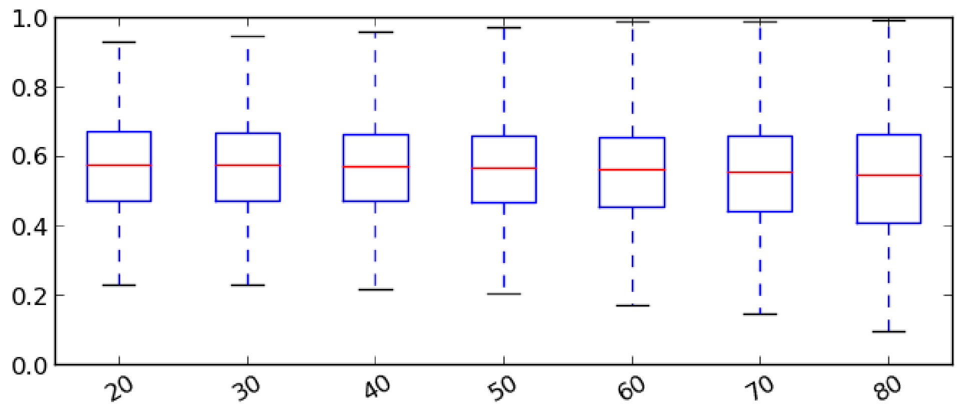


(c) Expected Distance to Assignment

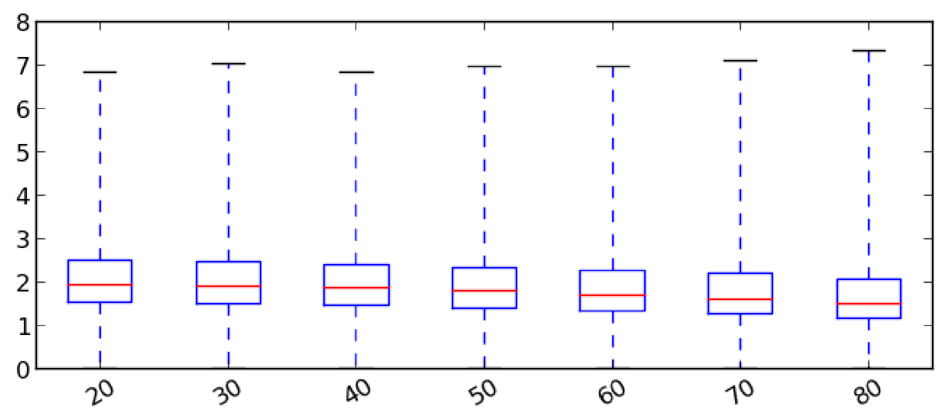
Figure 30: Current 3-Zone using old processing order. The horizontal axis shows what would happen if we replaced the walk zone set-aside in every school currently set to 50% to another percentage. As can be seen, the old processing order only starts to make a large aggregate at some point beyond 50% set aside, because open competition itself would fill most schools with 50% walk-students, in which case the old processing order does not prioritize walk-students more.



(a) Effective Access to Top 50% MCAS

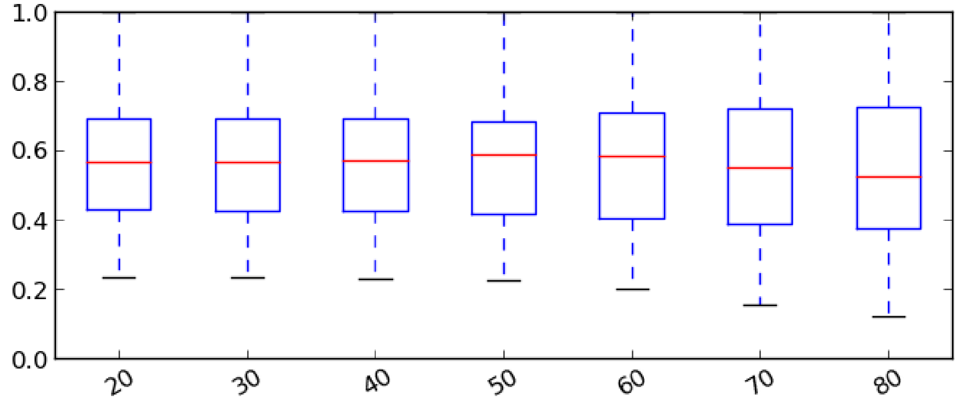


(b) Access to Top 3 choice

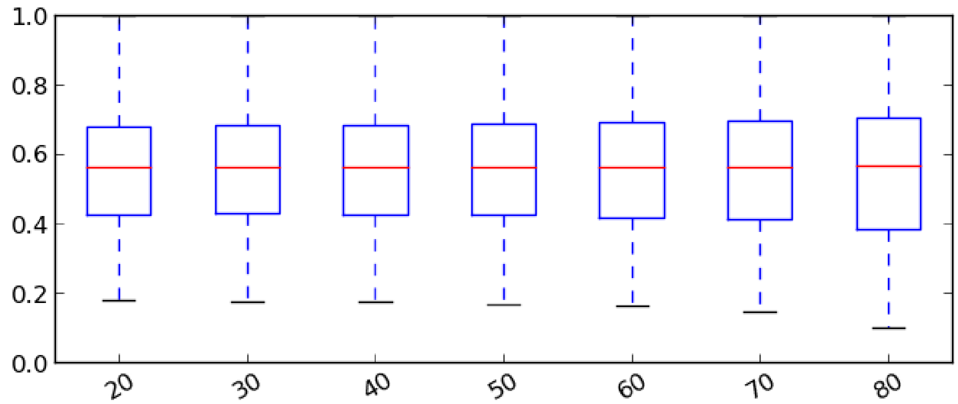


(c) Expected Distance to Assignment

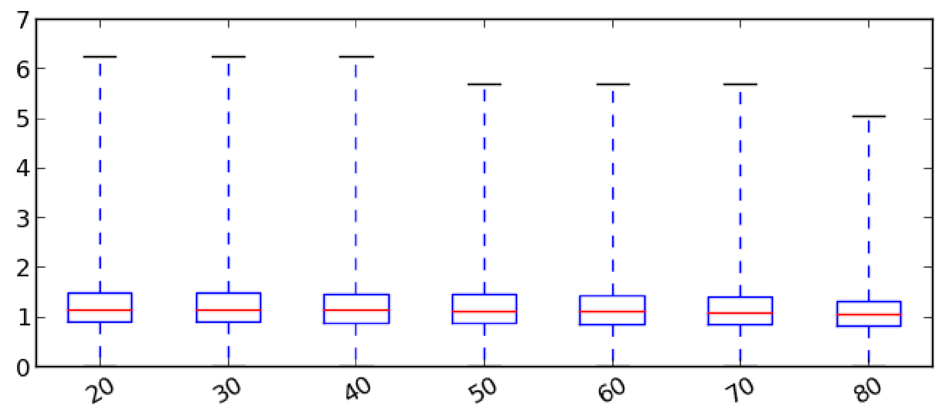
Figure 31: Current 3-Zone using new processing order. The horizontal axis shows what would happen if we replaced the walk zone set-aside in every school currently set to 50% to another percentage. As can be seen, the new processing order seems to have an effect at all levels (not only after 50%).



(a) Effective Access to Top 50% MCAS

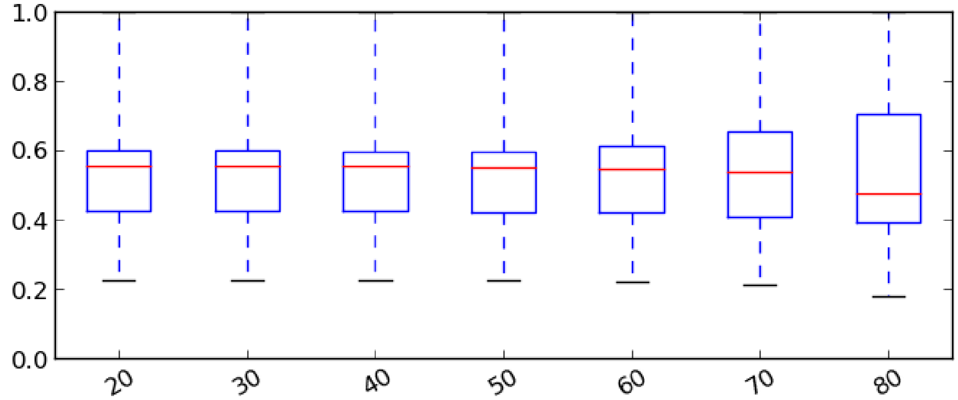


(b) Access to Top 3 choice

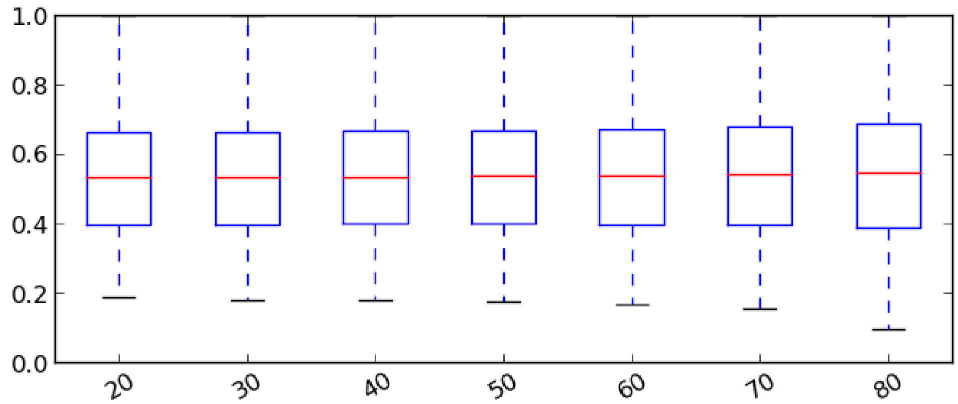


(c) Expected Distance to Assignment

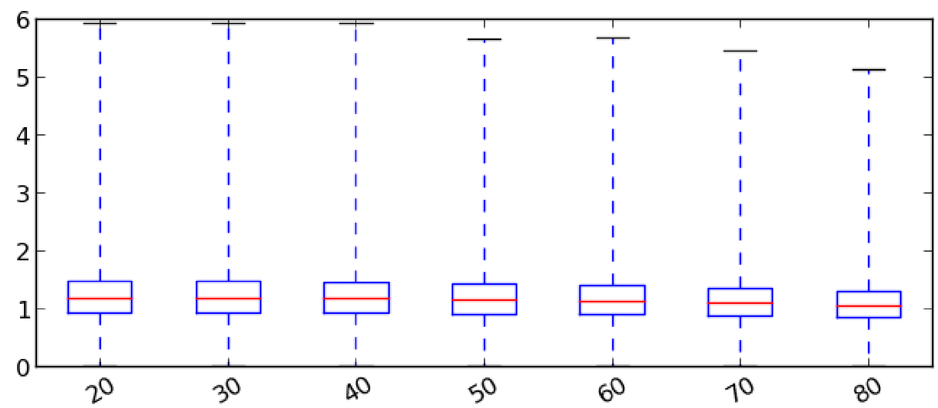
Figure 32: 10-Zone using new processing order. The horizontal axis shows what would happen if we replaced the walk zone set-aside in every school currently set to 50% to another percentage. In general, as walk zone set-aside increases, equity of access to quality decreases (access of worst-off student decreases), predictability increases for some and decreases for others, while distance decreases.



(a) Effective Access to Top 50% MCAS

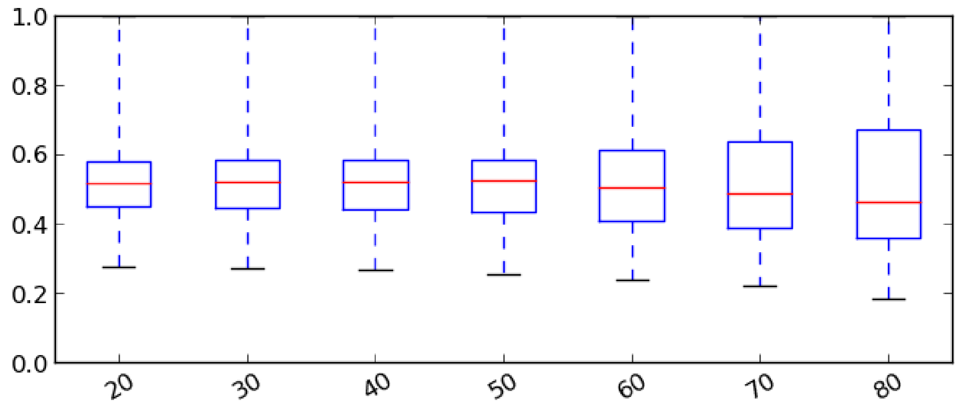


(b) Access to Top 3 choice

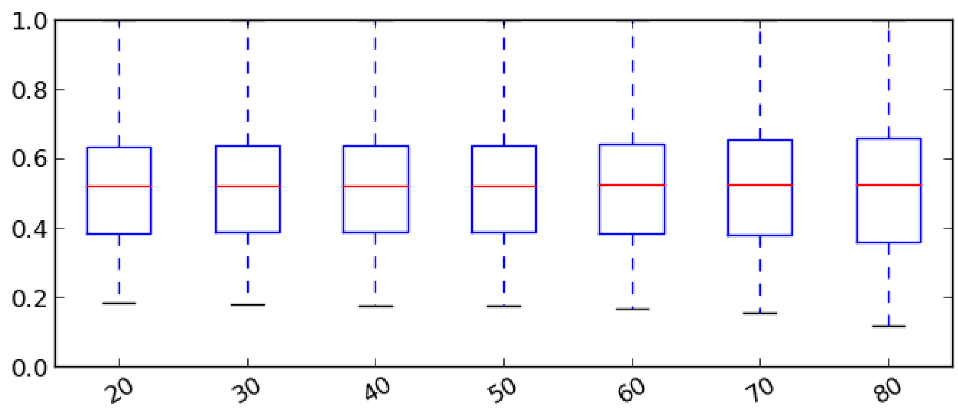


(c) Expected Distance to Assignment

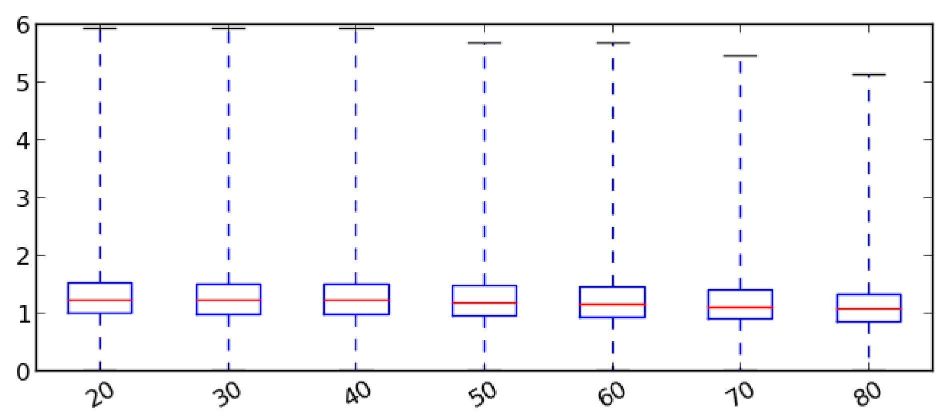
Figure 33: Closest Types 1 using new processing order. The horizontal axis shows what would happen if we replaced the walk zone set-aside in every school currently set to 50% to another percentage. In general, as walk zone set-aside increases, equity of access to quality decreases (defined as access of worst-off student decreases), access to top menu choice increases for some and decreases for others, while distance decreases.



(a) Effective Access to Top 50% MCAS



(b) Access to Top 3 choice



(c) Expected Distance to Assignment

Figure 34: Closest Types 2 using new processing order. The horizontal axis shows what would happen if we replaced the walk zone set-aside in every school currently set to 50% to another percentage. In general, as walk zone set-aside increases, equity of access to quality decreases (defined as access of worst-off student decreases), access to top menu choice increases for some and decreases for others, while distance decreases.

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