**Appendix to** [***Class Size and Resource Allocation* ESEpolicy brief**](http://www.doe.mass.edu/research/reports/2017/12class-size.docx)**, December 2017**

This appendix provides a more detailed description of Massachusetts class size data used in the [policy brief *Class Size and Resource Allocation*](http://www.doe.mass.edu/research/reports/2017/12class-size.docx)issued by the Massachusetts Department of Elementary and Secondary Education (ESE)*,* as well as the summary statistics and cross-district regression results summarized in Table 2 of the brief.

The data set used to perform these analyses was primarily generated from the October 1, 2016 (SY2016–17) data collection of the Student Information Management System (SIMS), Educational Personnel Information Management System (EPIMS), and Student Course Schedule (SCS) data files. A class is reported as a unique school, course, section, and term from SCS, for active classes at the beginning of the year. The aggregated data file identifies the number of students in each class, as well as the number of teachers as both full-time equivalents and head count.

To construct the analysis, we consider elementary school and middle/high school as the two models for how classes are organized. In elementary schools, the core courses of math, ELA, science, and social studies are typically taught in one class with one teacher. We refer to these as general education classes. In middle/high schools, students change classes for every course subject. Therefore, we focus on class size for math and ELA classes. A complication is that grades 5 and 6 can follow either the elementary school or the middle/high school model, or even some hybrid. This is often influenced by the school that the grade 5 or 6 class is in. For example, if a fifth grade is in a K–5 elementary school, then it tends to be organized like the elementary school model, whereas if a fifth grade is in a 5–8 middle school, it tends to be organized using the middle/high school model. To analyze class sizes in grades 5 and 6, we grouped general education classes with math and ELA classes in the analysis. Then for all grades we remove duplicate cases of teachers, virtual schools, and classes with the class size variable missing. Lastly, we limit our analysis to classes in which fewer than 75 percent of the students have disabilities, and to classes in the middle 90 percent of the class size distribution (that is, dropping classes in the bottom and top 5 percent of class sizes statewide).

To conduct further analysis about district class sizes using variables such as size of district, we worked with our class size data for grades 1, 4, 7, and 10. For grades 1 and 4, this corresponds to general education classes in first grades in Massachusetts public, non-charter schools. These are classes that cover the core subjects of mathematics, English language arts, science, and social studies. For grades 7 and 10, we looked at math class sizes only. We added variables from additional data on grade, school, and district enrollments, student and teacher characteristics and district financial information taken from the [ESE Profiles website](http://profiles.doe.mass.edu/state_report). Finally, data on school district residential characteristics are obtained from the American Community Survey. Aside from these variables, we also compared class sizes in traditional and charter districts.

The resulting analyses of class sizes by grade, district, student, teacher and residential characteristics for grades 1, 4, 7 and 10, and for non-charter (traditional) schools are presented in the following tables:

* Summary Statistics: District-level Means for Traditional Schools
* Regression Results for Mean Class Size: Cross-District Results for Traditional Schools

**Grade 1 Results**

| **Table 1.1 – Summary Statistics for Grade 1**  District-Level Variables: Traditional (Non-charter) Schools | | | | | |
| --- | --- | --- | --- | --- | --- |
| Variables | Obs. | Mean | Std. | Min | Max |
| **Grade Characteristics** |  |  |  |  |  |
| Mean class size for general education classes | 242 | 19.27 | 2.13 | 14 | 25 |
| Number of general education classes | 242 | 10.82 | 13.47 | 1 | 141 |
| Number of schools with general education classes | 242 | 3.43 | 5.32 | 1 | 65 |
| Total grade enrollment (in 100s) | 242 | 2.49 | 3.65 | 0.03 | 40.05 |
| 5-year change in grade enrollment | 242 | -8.26 | 43.54 | -359 | 325 |
| **District Characteristics** |  |  |  |  |  |
| District total enrollment (in 100s) | 242 | 32.58 | 47.28 | 0.59 | 532.63 |
| Five-year change in district enrollment | 242 | -0.29 | 3.63 | -17.64 | 26.78 |
| Berkshires Region=1 | 242 | 0.05 | 0.22 | 0 | 1 |
| Central Region=1 | 242 | 0.17 | 0.38 | 0 | 1 |
| Greater Boston Region=1 | 242 | 0.17 | 0.37 | 0 | 1 |
| Northeast Region=1 | 242 | 0.16 | 0.36 | 0 | 1 |
| Pioneer Valley Region=1 | 242 | 0.15 | 0.36 | 0 | 1 |
| Southeast Region=1 | 242 | 0.26 | 0.44 | 0 | 1 |
| Commissioner’s Districts=1 | 242 | 0.04 | 0.20 | 0 | 1 |
| In-district per pupil expenditure (in $1,000s) | 242 | 15.26 | 3.89 | 10.38 | 39.50 |
| Teachers per 100 students | 242 | 8.02 | 1.41 | 5.62 | 15.15 |
| **Student Characteristics** |  |  |  |  |  |
| Proportion students with disabilities | 242 | 0.17 | 0.03 | 0.05 | 0.29 |
| Proportion limited English proficient | 242 | 0.05 | 0.07 | 0.00 | 0.34 |
| Proportion economically disadvantaged | 242 | 0.23 | 0.15 | 0.03 | 0.75 |
| Proportion African-American | 242 | 0.04 | 0.07 | 0.00 | 0.57 |
| Proportion Hispanic | 242 | 0.10 | 0.14 | 0.00 | 0.92 |
| **Teacher Characteristics** |  |  |  |  |  |
| Proportion licensed teachers | 242 | 0.99 | 0.02 | 0.84 | 1.00 |
| Proportion classes by highly qualified teachers | 242 | 0.98 | 0.09 | 0.00 | 1.00 |
| **District Residential Characteristics** |  |  |  |  |  |
| Median household income (in $1,000s) | 242 | 81.45 | 28.15 | 34.73 | 199.52 |
| Proportion with at least a bachelor’s degree | 242 | 0.43 | 0.17 | 0.11 | 0.85 |

**Table 1.2 – Cross-District Regression Results for Grade 1**

|  | Coefficient Estimates |  |
| --- | --- | --- |
| **Grade Characteristics** |  |  |
| Number of schools with grade 1 general education classes | -0.388\*\*\* |  |
|  | (0.097) |  |
| Total grade enrollment (in 100s) | 0.544 |  |
|  | (0.377) |  |
| 5-year change in grade enrollment | 0.011\*\* |  |
|  | (0.005) |  |
| **District Characteristics** |  |  |
| Total district enrollment (in 100s) | 0.022 |  |
|  | (0.030) |  |
| 5-year change in district enrollment (in 100s) | -0.018 |  |
|  | (0.045) |  |
| Berkshires Region=1 | 1.405 |  |
|  | (0.940) |  |
| Other Regions=1 | 1.598\* |  |
|  | (0.821) |  |
| In-district per pupil expenditures (in $1,000s) | -0.132\*\*\* |  |
|  | (0.046) |  |
| **Student Characteristics** |  |  |
| Proportion students with disabilities | 0.440 |  |
|  | (5.669) |  |
| Proportion limited English proficient | -1.943 |  |
|  | (2.790) |  |
| Proportion economically disadvantaged | -0.146 |  |
|  | (2.256) |  |
| **District Residential Characteristics** |  |  |
| Median household income (in $1,000s) | 0.007 |  |
|  | (0.008) |  |
| Proportion with at least a bachelor’s degree | -1.512 |  |
|  | (1.365) |  |
| Constant | 19.243\*\*\* |  |
|  | (1.480) |  |
| N | 242 |  |
|  | R2 Total | R2 Partial |
| All | 0.328 |  |
| Grade | 0.214 | 0.067 |
| District | 0.247 | 0.057 |
| Student | 0.032 | 0.001 |
| Residential | 0.046 | 0.004 |
| Robust standard errors in parentheses  \*, \*\*, \*\*\*: significant at 10%, 5%, and 1 percent level |  |  |

**Grade 4 Results**

| **Table 2.1 – Summary Statistics for Grade 4**  District-Level Variables: Traditional (Non-charter) Schools | | | | | |
| --- | --- | --- | --- | --- | --- |
| Variables | Obs. | Mean | Std. | Min | Max |
| **Grade Characteristics** |  |  |  |  |  |
| Mean class size for general education classes | 224 | 20.74 | 2.34 | 15 | 25.80 |
| Number of general education classes | 224 | 9.36 | 11.77 | 1 | 98 |
| Number of schools with general education classes | 224 | 3.17 | 4.59 | 1 | 48 |
| Total grade enrollment (in 100s) | 224 | 2.75 | 3.90 | 0.15 | 42.59 |
| 5-year change in grade enrollment | 223 | 9.57 | 65.01 | -101 | 446 |
| **District Characteristics** |  |  |  |  |  |
| District total enrollment (in 100s) | 224 | 33.94 | 48.84 | 1.05 | 532.63 |
| Five-year change in district enrollment | 223 | -0.23 | 3.76 | -17.64 | 26.78 |
| Berkshires Region=1 | 224 | 0.06 | 0.23 | 0 | 1 |
| Central Region=1 | 224 | 0.17 | 0.38 | 0 | 1 |
| Greater Boston Region=1 | 224 | 0.17 | 0.38 | 0 | 1 |
| Northeast Region=1 | 224 | 0.15 | 0.36 | 0 | 1 |
| Pioneer Valley Region=1 | 224 | 0.16 | 0.37 | 0 | 1 |
| Southeast Region=1 | 224 | 0.24 | 0.43 | 0 | 1 |
| Commissioner’s Districts=1 | 224 | 0.04 | 0.21 | 0 | 1 |
| In-district per pupil expenditure (in $1,000s) | 224 | 15.06 | 3.54 | 9.97 | 34.93 |
| Teachers per 100 students | 224 | 7.98 | 1.36 | 5.62 | 15.15 |
| **Student Characteristics** |  |  |  |  |  |
| Proportion students with disabilities | 224 | 0.17 | 0.03 | 0.05 | 0.27 |
| Proportion limited English proficient | 224 | 0.05 | 0.07 | 0.00 | 0.34 |
| Proportion economically disadvantaged | 224 | 0.23 | 0.15 | 0.03 | 0.75 |
| Proportion African-American | 224 | 0.04 | 0.07 | 0.00 | 0.57 |
| Proportion Hispanic | 224 | 0.11 | 0.14 | 0.00 | 0.92 |
| **Teacher Characteristics** |  |  |  |  |  |
| Proportion licensed teachers | 224 | 0.99 | 0.02 | 0.84 | 1.00 |
| Proportion classes by highly qualified teachers | 222 | 0.98 | 0.03 | 0.81 | 1.00 |
| **District Residential Characteristics** |  |  |  |  |  |
| Median household income (in $1,000s) | 224 | 81.51 | 27.75 | 34.73 | 185.54 |
| Proportion with at least a bachelor’s degree | 224 | 0.43 | 0.17 | 0.11 | 0.85 |

**Table 2.2 – Cross-District Regression Results for Grade 4**

|  | Coefficient Estimates |  |
| --- | --- | --- |
| **Grade Characteristics** |  |  |
| Number of schools with grade 4 general education classes | -0.333\*\*\* |  |
|  | (0.105) |  |
| Total grade enrollment (in 100s) | -0.401 |  |
|  | (0.404) |  |
| 5-year change in grade enrollment | 0.004 |  |
|  | (0.003) |  |
| **District Characteristics** |  |  |
| Total district enrollment (in 100s) | 0.068\* |  |
|  | (0.037) |  |
| 5-year change in district enrollment (in 100s) | 0.039 |  |
|  | (0.040) |  |
| Berkshires Region=1 | 0.712 |  |
|  | (0.852) |  |
| Other Regions=1 | 1.798\*\* |  |
|  | (0.739) |  |
| In-district per pupil expenditures (in $1,000s) | -0.268\*\*\* |  |
|  | (0.040) |  |
| **Student Characteristics** |  |  |
| Proportion students with disabilities | -3.073 |  |
|  | (5.160) |  |
| Proportion limited English proficient | 3.546 |  |
|  | (3.376) |  |
| Proportion economically disadvantaged | 2.964 |  |
|  | (2.189) |  |
| **District Residential Characteristics** |  |  |
| Median household income (in $1,000s) | 0.015\* |  |
|  | (0.008) |  |
| Proportion with at least a bachelor’s degree | -0.721 |  |
|  | (1.541) |  |
| Constant |  |  |
|  | 21.692\*\*\* |  |
| N | (1.470) |  |
|  | 224 |  |
|  | R2 Total | R2 Partial |
| All |  |  |
| Grade | 0.398 |  |
| District | 0.160 | 0.050 |
| Student | 0.316 | 0.187 |
| Residential | 0.055 | 0.015 |
| District Residential | 0.052 | 0.007 |
| Robust standard errors in parentheses  \*, \*\*, \*\*\*: significant at 10%, 5%, and 1 percent level |  |  |

**Grade 7 Results**

| **Table 3.1 – Summary Statistics for Grade 7 Math**  District-Level Variables: Traditional (Non-charter) Schools | | | | | |
| --- | --- | --- | --- | --- | --- |
| Variables | Obs. | Mean | Std. | Min | Max |
| **Grade Characteristics** |  |  |  |  |  |
| Mean class size for general education classes | 216 | 19.60 | 3.06 | 10 | 28 |
| Number of general education classes | 216 | 12.77 | 12.74 | 1 | 123 |
| Number of schools with general education classes | 216 | 1.82 | 3.02 | 1 | 39 |
| Total grade enrollment (in 100s) | 216 | 2.77 | 3.21 | 0.10 | 33.13 |
| 5-year change in grade enrollment | 215 | -7.00 | 51.69 | -579 | 143 |
| **District Characteristics** |  |  |  |  |  |
| District total enrollment (in 100s) | 216 | 35.58 | 48.57 | 0.81 | 532.63 |
| Five-year change in district enrollment | 215 | -0.49 | 3.40 | -17.64 | 15.68 |
| Berkshires Region=1 | 216 | 0.06 | 0.23 | 0 | 1 |
| Central Region=1 | 216 | 0.19 | 0.39 | 0 | 1 |
| Greater Boston Region=1 | 216 | 0.18 | 0.39 | 0 | 1 |
| Northeast Region=1 | 216 | 0.16 | 0.37 | 0 | 1 |
| Pioneer Valley Region=1 | 216 | 0.13 | 0.34 | 0 | 1 |
| Southeast Region=1 | 216 | 0.24 | 0.43 | 0 | 1 |
| Commissioner’s Districts=1 | 216 | 0.05 | 0.21 | 0 | 1 |
| In-district per pupil expenditure (in $1,000s) | 216 | 14.93 | 3.23 | 9.97 | 39.50 |
| Teachers per 100 students | 216 | 7.92 | 1.19 | 5.62 | 14.49 |
| **Student Characteristics** |  |  |  |  |  |
| Proportion students with disabilities | 216 | 0.17 | 0.03 | 0.05 | 0.27 |
| Proportion limited English proficient | 216 | 0.05 | 0.07 | 0.00 | 0.34 |
| Proportion economically disadvantaged | 216 | 0.24 | 0.16 | 0.03 | 0.75 |
| Proportion African-American | 216 | 0.04 | 0.07 | 0.00 | 0.57 |
| Proportion Hispanic | 216 | 0.11 | 0.15 | 0.00 | 0.92 |
| **Teacher Characteristics** |  |  |  |  |  |
| Proportion licensed teachers | 216 | 0.99 | 0.02 | 0.90 | 1.00 |
| Proportion classes by highly qualified teachers | 214 | 0.98 | 0.03 | 0.80 | 1.00 |
| **District Residential Characteristics** |  |  |  |  |  |
| Median household income (in $1,000s) | 216 | 80.83 | 27.76 | 34.73 | 199.52 |
| Proportion with at least a bachelor’s degree | 216 | 0.41 | 0.17 | 0.11 | 0.83 |

**Table 3.2 – Cross-District Regression Results for Grade 7 Math**

|  | Coefficient Estimates |  |
| --- | --- | --- |
| **Grade Characteristics** |  |  |
| Number of schools with grade 7 math classes | 0.364\*\* |  |
|  | (0.155) |  |
| Total grade enrollment (in 100s) | 0.322 |  |
|  | (0.485) |  |
| 5-year change in grade enrollment | 0.020\*\*\* |  |
|  | (0.006) |  |
| **District Characteristics** |  |  |
| Total district enrollment (in 100s) | -0.017 |  |
|  | (0.033) |  |
| 5-year change in district enrollment (in 100s) | -0.044 |  |
|  | (0.083) |  |
| Berkshires Region=1 | -1.447 |  |
|  | (1.532) |  |
| Other Regions=1 | 0.616 |  |
|  | (1.164) |  |
| In-district per pupil expenditures (in $1,000s) | -0.383\*\*\* |  |
|  | (0.066) |  |
| **Student Characteristics** |  |  |
| Proportion students with disabilities | -7.253 |  |
|  | (7.183) |  |
| Proportion limited English proficient | -3.106 |  |
|  | (4.974) |  |
| Proportion economically disadvantaged | 3.186 |  |
|  | (3.076) |  |
| **District Residential Characteristics** |  |  |
| Median household income (in $1,000s) | 0.029\*\* |  |
|  | (0.014) |  |
| Proportion with at least a bachelor’s degree | -2.366 |  |
|  | (2.454) |  |
| Constant | 23.308\*\*\* |  |
|  | (2.226) |  |
| N | 216 |  |
|  | R2 Total | R2 Partial |
| All | 0.377 |  |
| Grade | 0.111 | 0.042 |
| District | 0.318 | 0.137 |
| Student | 0.017 | 0.006 |
| District Residential | 0.073 | 0.014 |
| Robust standard errors in parentheses  \*, \*\*, \*\*\*: significant at 10%, 5%, and 1 percent level |  |  |

**Grade 10 Results**

| **Table 4.1 – Summary Statistics for Grade 10 Math**  District-Level Variables: Traditional (Non-charter) Schools | | | | | |
| --- | --- | --- | --- | --- | --- |
| Variables | Obs. | Mean | Std. | Min | Max |
| **Grade Characteristics** |  |  |  |  |  |
| Mean class size for general education classes | 220 | 19.20 | 3.20 | 9.67 | 26.15 |
| Number of general education classes | 220 | 11.73 | 13.22 | 1 | 161 |
| Number of schools with general education classes | 220 | 1.27 | 1.94 | 1 | 28 |
| Total grade enrollment (in 100s) | 220 | 2.73 | 3.34 | 0.28 | 38.95 |
| 5-year change in grade enrollment | 218 | -1.58 | 39.45 | -183 | 188 |
| **District Characteristics** |  |  |  |  |  |
| District total enrollment (in 100s) | 220 | 34.84 | 48.09 | 4.42 | 532.63 |
| Five-year change in district enrollment | 218 | -0.23 | 3.79 | -17.64 | 26.78 |
| Berkshires Region=1 | 220 | 0.05 | 0.21 | 0 | 1 |
| Central Region=1 | 220 | 0.20 | 0.40 | 0 | 1 |
| Greater Boston Region=1 | 220 | 0.17 | 0.37 | 0 | 1 |
| Northeast Region=1 | 220 | 0.16 | 0.37 | 0 | 1 |
| Pioneer Valley Region=1 | 220 | 0.12 | 0.33 | 0 | 1 |
| Southeast Region=1 | 220 | 0.26 | 0.44 | 0 | 1 |
| Commissioner’s Districts=1 | 220 | 0.04 | 0.20 | 0 | 1 |
| In-district per pupil expenditure (in $1,000s) | 220 | 15.29 | 3.42 | 9.97 | 32.36 |
| Teachers per 100 students | 220 | 7.93 | 1.15 | 5.62 | 12.50 |
| **Student Characteristics** |  |  |  |  |  |
| Proportion students with disabilities | 220 | 0.18 | 0.05 | 0.09 | 0.48 |
| Proportion limited English proficient | 220 | 0.04 | 0.06 | 0.00 | 0.34 |
| Proportion economically disadvantaged | 220 | 0.24 | 0.15 | 0.03 | 0.74 |
| Proportion African-American | 220 | 0.04 | 0.07 | 0.00 | 0.57 |
| Proportion Hispanic | 220 | 0.11 | 0.14 | 0.00 | 0.92 |
| **Teacher Characteristics** |  |  |  |  |  |
| Proportion licensed teachers | 220 | 0.99 | 0.02 | 0.92 | 1.00 |
| Proportion classes by highly qualified teachers | 219 | 0.98 | 0.03 | 0.81 | 1.00 |
| **District Residential Characteristics** |  |  |  |  |  |
| Median household income (in $1,000s) | 220 | 81.42 | 26.45 | 34.73 | 172.81 |
| Proportion with at least a bachelor’s degree | 220 | 0.42 | 0.17 | 0.11 | 0.83 |

**Table 4.2 – Cross-District Regression Results for Grade 10 Math**

|  | Coefficient Estimates |  |
| --- | --- | --- |
| **Grade Characteristics** |  |  |
| Number of schools with grade 10 math classes | -0.501 |  |
|  | (0.325) |  |
| Total grade enrollment (in 100s) | 1.194\*\*\* |  |
|  | (0.375) |  |
| 5-year change in grade enrollment | 0.002 |  |
|  | (0.006) |  |
| **District Characteristics** |  |  |
| Total district enrollment (in 100s) | -0.053\* |  |
|  | (0.029) |  |
| 5-year change in district enrollment (in 100s) | 0.007 |  |
|  | (0.076) |  |
| Berkshires Region=1 | 3.566 |  |
|  | (3.675) |  |
| Other Regions=1 | 3.516 |  |
|  | (3.283) |  |
| In-district per pupil expenditures (in $1,000s) | -0.307\*\*\* |  |
|  | (0.086) |  |
| **Student Characteristics** |  |  |
| Proportion students with disabilities | -0.828 |  |
|  | (5.227) |  |
| Proportion limited English proficient | 7.216 |  |
|  | (6.785) |  |
| Proportion economically disadvantaged | -2.128 |  |
|  | (3.285) |  |
| **District Residential Characteristics** |  |  |
| Median household income (in $1,000s) | -0.014 |  |
|  | (0.016) |  |
| Proportion with at least a bachelor’s degree | 3.082 |  |
|  | (2.404) |  |
| Constant | 19.962\*\*\* |  |
|  | (4.069) |  |
| N | 220 |  |
|  | R2 Total | R2 Partial |
| All | 0.182 |  |
| Grade | 0.050 | 0.048 |
| District | 0.118 | 0.079 |
| Student | 0.064 | 0.006 |
| District Residential | 0.023 | 0.005 |
| Robust standard errors in parentheses  \*, \*\*, \*\*\*: significant at 10%, 5%, and 1 percent level |  |  |