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April 2012

Prepared by

Jacqueline Raphael
Education Northwest

Nicole Sage, Ph.D.
Education Northwest

Ann Ishimaru, Ed.D.
Education Northwest

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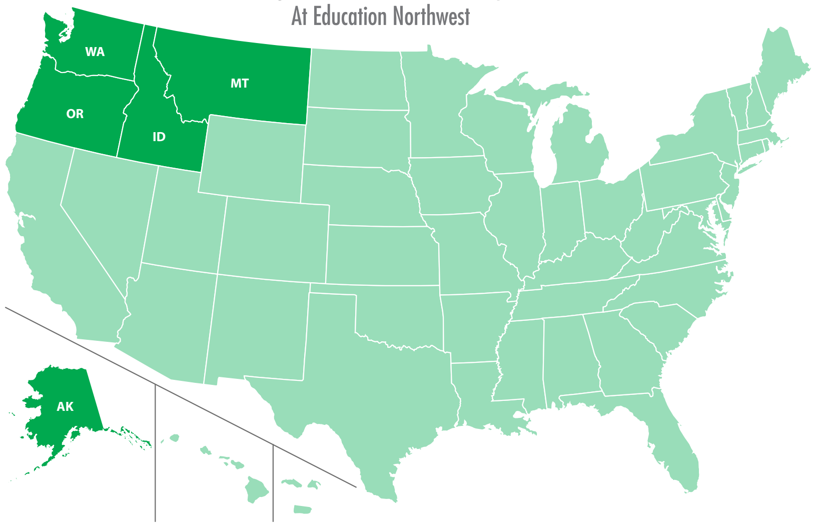

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Meeting Oregon's new high school math graduation requirements: examining student enrollment and teacher availability

At least 11 percent of grade 9–12 students in Oregon would have been off track to meet the state's new rigorous math requirements for the class of 2014 and beyond had the requirements been in place during 2006/07 and 2007/08. Only 62–80 percent of students would have had access to teachers endorsed to teach advanced math if staffing levels had remained at 2006/07 and 2007/08 levels.

For almost three decades, policymakers across the United States have recommended that high school students take a greater number of academic courses (and more advanced courses) to better prepare for college and the workforce. States have responded by raising graduation requirements, particularly in math. Between 2000 and 2008, 37 states increased the number of math courses required for graduation (Stillman and Blank 2009). Further, 20 states and the District of Columbia now require that all high school graduates complete math coursework at least through algebra II or its equivalent (Achieve 2011). States must pay close attention to course-taking trends so that they can meet the design and implementation challenges that arise when increasing these requirements (Achieve 2007).

Oregon is among the states that have increased both the number of math courses and the minimum level of content required for high school graduation (Oregon Educational Act for the 21st Century 2009). Starting with the class of 2014, students will be required to take three years of math at or above the algebra I level, including geometry. But both Oregon and the Northwest Region face a shortage of qualified math teachers (U.S. Department of Education 2011; Zanville 2006), so many schools could find it difficult to enroll students in coursework sufficiently rigorous to meet these new requirements. And though Oregon law mandates that all students have an equal opportunity to take these courses from teachers endorsed to teach advanced math, the potentially greater level of need in some types of schools—such as small schools and those with high populations of students eligible for free or reduced-price lunch—suggests that the Oregon Department of Education might target support especially to such schools.

Disaggregating the data across four school variables—size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch—this study examines the extent to which Oregon grade 9–12 students enrolled in high school math courses

during 2006/07 and 2007/08 would not have been on track to graduate had the new graduation requirements for the class of 2014 and beyond been in place. It looks also at how well the state's 2006/07 and 2007/08 availability of advanced math–endorsed teachers would meet the increased demand stemming from the new requirements. Students were considered off track if they were enrolled in a course that would not allow them, by completing no more than one math course per year, to complete by grade 12 the required three classes at the level of algebra I and above.

Four research questions guide this study:

- What percentage of Oregon's grade 9–12 students enrolled in high school math classes in 2006/07 and 2007/08 would not have been on track to meet the state's new graduation requirements for the class of 2014 and beyond had the requirements been in place?

- How does the percentage of Oregon's grade 9–12 students enrolled in high school math classes who would not have been on track to meet the state's new graduation requirements vary by school size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch?

- How well does the 2006/07 and 2007/08 availability of advanced math–endorsed teachers for grades 9–12 meet the increased demand for advanced math courses that will result from the new requirements?

- How does the relationship between the availability of advanced math–endorsed teachers and the grade 9–12 demand for advanced math courses vary by school size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch?

Two assumptions underlie the study: that all grade 9 students enrolled in math courses below the algebra I level are on track to meet the new requirements if they complete three courses at or above the algebra I level in grades 10–12 (for a total of four years of high school–level math) and that it may be sufficient for students to complete two courses at the algebra I level and then the required geometry course to meet the new graduation requirements.

Key findings include:

- Had the new graduation requirements for the class of 2014 and beyond been in place during the two study years, at least 11 percent of grade 9–12 students would have been off track to meet the new requirements.

- Of the subcategories within each school type, those with the greatest proportion of students who would not have been on track to meet the new requirements were small schools (18 percent), schools in towns (14 percent), schools with a high racial/ethnic minority population (15 percent), and schools with a high population eligible for free or reduced-price lunch (16 percent).

- Had the availability of advanced math–endorsed teachers remained at 2006/07 and 2007/08 levels, 62–80 percent of grade

9–12 students needing to take advanced math courses would have had access to these teachers under the new requirements, depending on how demand was estimated.

- Grade 9–12 students in small schools would have faced a lower availability of advanced math–endorsed teachers than students in other school size subcategories would have (29–47 percent, depending on how demand for advanced math–endorsed teachers was estimated); schools with a low population eligible for free or reduced-price lunch would have faced a higher availability than students in other subcategories of free or reduced-price lunch–eligible population would have (75–88 percent, depending on how demand for advanced math–endorsed teachers was estimated).

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WHY THIS STUDY?

For almost three decades, policymakers across the United States have recommended that high school students take more academic courses (and more advanced courses) to better prepare for college and the workforce. States have responded by raising graduation requirements, particularly in math. Between 2000 and 2008, 37 states increased the number of math courses required for graduation (Stillman and Blank 2009). Further, 20 states and the District of Columbia now require that all high school graduates complete math coursework at least through algebra II or its equivalent (Achieve 2011).

Starting in 2005, the Oregon Educational Act for the 21st Century increased both the number and level of math courses required to graduate from high school. Before the change, high school students were required to take two math courses at any content level (table 1). Now, students graduating in 2010–13 are required to complete three math courses at any level, and beginning with the class of 2014, students must complete at least three math courses at the algebra I level or above,[1] including geometry. Students may take a sequence of two courses at the algebra I level and geometry or a sequence of algebra I, geometry, and algebra II/trigonometry, among other options.

This study looks at the extent to which Oregon grade 9–12 students who were enrolled in high school

TABLE 1
Timeline for implementing Oregon's new math graduation requirements

Graduating class	Number of math courses	Level of math courses
Before 2010	2	None specified
2010–13	3	None specified
2014 on	3	Algebra I and above,[a] including geometry

a. Refers to required content specified in the High School Mathematics Academic Content Standards, adopted by the Oregon State Board of Education in 2009.

Source: Authors' analysis based on data from Oregon Department of Education (2009, 2011).

States must pay close attention to course-taking trends so that they can meet at least two design and implementation challenges that arise when graduation requirements are raised: schools without a history of enrolling students in rigorous math courses could find the new requirements difficult to implement and states might not have enough teachers endorsed to teach advanced math courses

math courses during 2006/07 and 2007/08 would have been on track to graduate had the new graduation requirements for the class of 2014 and beyond been in place. It looks also at how well the state's 2006/07 and 2007/08 availability of advanced math–endorsed teachers would meet the increased demand stemming from these new requirements.[2] Students were considered off track if they were enrolled in a course that would not allow them, by completing no more than one math course per year, to complete by grade 12 the required three classes at the level of algebra I and above (see box 1 for a description of the study's data and methodology and see appendix A for more detail).

New requirements, new challenges

States must pay close attention to course-taking trends so that they can meet at least two design and implementation challenges that arise when graduation requirements are raised (Achieve 2007). First, schools without a history of enrolling students in rigorous math courses could find the new requirements difficult to implement. Indeed, many students might need better preparation, likely starting well before high school, to be on track to complete three courses at or above the algebra I level.

Second, states might not have enough teachers endorsed to teach advanced math courses (geometry, algebra II, trigonometry, and precalculus/calculus). Since 2007/08, math has been designated as a teacher shortage subject area in Oregon (Baird 2011; U.S. Department of Education 2011). Increased recruitment led Oregon's teacher preparation programs to produce more newly licensed math teachers—a 401 percent increase over 2001/02–2005/06—but "many of the math endorsements were in basic math, which does not permit teachers to teach advanced-level high school math" (courses above the algebra I level; Zanville 2006, p. 5). Even if the state can retain enough licensed math teachers overall, the increased math requirements could result in a need for more teachers with advanced math endorsements.

Anticipating these challenges, the Oregon Department of Education requested that this study include an analysis by school size and locale. Racial/ethnic minority population and the population of students eligible for free or reduced-price lunch were added to the analysis because national statistics suggest that some students (particularly racial/ethnic minority and students from low-income households) are less likely to enroll in advanced high school courses (Adelman 2006; Planty et al. 2007).

Research questions

Four research questions guide this study:

- What percentage of Oregon's grade 9–12 students enrolled in high school math classes in 2006/07 and 2007/08 would not have been on track to meet the state's new graduation requirements for the class of 2014 and beyond had the requirements been in place?
- How does the percentage of Oregon's grade 9–12 students enrolled in high school math classes who would not have been on track to meet the state's new graduation requirements vary by school size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch?
- How well does the 2006/07 and 2007/08 availability of advanced math–endorsed teachers for grades 9–12 meet the increased demand for advanced math courses that will result from the new requirements?
- How does the relationship between the availability of advanced math–endorsed teachers and the grade 9–12 demand for advanced math courses vary by school size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch?

BOX 1

Data and methodology

Data sources. Data on student enrollment, teacher endorsements, and school demographics were obtained from five databases:

- The Oregon Department of Education class size collections (2006/07 and 2007/08) include a record for every class section taught in Oregon schools, by grade level and subject area, for each school year (Oregon Department Education 2007a, 2008a).
- The Oregon Department of Education aggregated student membership collections (2006/07 and 2007/08) include (by grade level) the number of students enrolled at each school, the number of students at each school eligible for free or reduced-price lunch, and the number of racial/ethnic minority students at each school for each school year (Oregon Department of Education 2007b, 2008b).
- The Common Core of Data school locale codes (2006/07) include the school identification number, school name, and urban-centric locale code for each school (U.S. Department of Education 2007).
- The Teacher Standards and Practices Commission endorsement collection (2008) contains subject-area endorsements of current and past teachers (Oregon Department of Education 2008c).
- The Oregon Department of Education staff assignment collections (2006/07 and 2007/08) include a record for each class taught in Oregon schools, by grade level and subject area. Multiple classes with the same course title (such as multiple algebra I classes in a high school) are treated as separate records. The teacher assigned to each class is recorded using a unique Oregon teacher identification number (Oregon Department of Education 2007c, 2008d).

Data organization. The datasets were prepared for analysis in four steps: obtaining student enrollment in high school math information, obtaining teacher endorsement information, obtaining school demographic information, and merging student enrollment, teacher endorsement, and school demographic information (see appendix A for details). Linking student enrollment directly to the endorsement of the teacher who taught the section would have required matching the staff assignment and class size collection course codes, class periods, and class locations for each school and section. This was not possible because of how the datasets were organized. Therefore, each data collection was separately aggregated to the school course level by content level and then merged.

The final dataset contained school-level information on student enrollment and teacher endorsements in five course content levels (see appendix B for details): below algebra I; algebra I (algebra I up to, but not including, geometry level); geometry (geometry up to, but not including, algebra II/trigonometry level); algebra II/trigonometry (algebra II/trigonometry up to, but not including, precalculus level); and precalculus and above.

Of the 565 schools that had students enrolled in high school–level math courses, 38—predominately small alternative schools—were excluded from the analysis due to missing data for at least one school variable. The 527 remaining schools were coded into one of four subcategories for each school variable:

- School size. The total number of students (all grade levels) enrolled in the school was used to define school size. Quartiles were used to define schools as small, small/medium, medium/large, and large. (The Oregon Department of Education requested that the study use quartiles so that the results align with other data analyzed by the department.)
- School locale. The 2006 Common Core of Data four main categories of the locale code variable were used to define schools as rural, town, suburb, or city.
- School racial/ethnic minority population. The total number of non-White (including Hispanic) students (all grade levels) enrolled in the school was divided by the total number of students in school to get the percentage of racial/ethnic minority students enrolled in the school. Quartiles

BOX 1 (CONTINUED)

Data and methodology

were used to define schools as low, low/medium, medium/high, or high racial/ethnic minority.

- School population eligible for free or reduced-price lunch. The total number of students eligible for free or reduced-price lunch (all grade levels) was divided by the total number of students in school to get the percentage of students enrolled in the school that are eligible for free or reduced-price lunch. Quartiles were used to define schools as low, low/medium, medium/high, or high population eligible for free or reduced-price lunch.

Preliminary analysis. The 527 schools included in the study had a total student membership of 294,244 students, 180,505 of them in grades 9–12. Of the 180,505 grade 9–12 students, 126,552 were enrolled in high school–level math classes. Those students were taught by 3,182 teachers in 8,344 math class sections.[1] Of the 3,182 teachers, 2,309 had either the basic or advanced math endorsement to teach high school math, and 873 were not endorsed to teach high school math. (See appendixes C–E for the results of the preliminary analysis, conducted to provide context for the findings.)

Main analysis. The main analysis consisted of calculating the number of students in 2006/07 and 2007/08 who would have been off track to graduate had the requirements been in place and determining how well the 2006/07 and 2007/08 supply of advanced math–endorsed teachers would meet the new demand for advanced math courses stemming from the requirements.

To calculate the proportion of students not on track, the total number of grade 9–12 students identified as not on track to meet the new graduation requirements had they been in place during the years studied was divided by the total number of grade 9–12 students (the number of grade 10, 11, and 12 students enrolled in below algebra I–level courses divided by the number of grade 9, 10, 11, and 12 students enrolled in school). Of 180,505 grade 9–12 students enrolled in school, 126,552 (70 percent) were enrolled in math courses. The remaining 30 percent not enrolled in any math course at the time of the study were not included in the estimate of students considered off track. Although it is unknown why 30 percent of grade 9–12 students were not enrolled in math courses, slightly less than three-quarters of these students were in grades 11 or 12, suggesting that many had already fulfilled the two-math-course requirement in place when they were in high school or that they had an individualized education program exempting them from math courses.

To determine the new demand for advanced math courses, the following assumptions and calculations were made:

- Current demand. The number of grade 9–12 students enrolled in geometry-level, algebra II/trigonometry–level, and precalculus-level courses (advanced courses), based on 2006/07 and 2007/08 enrollments.
- Additional demand. The number of additional grade 9–12 students who would need to take at least one advanced math course during their four years of high school to meet the new graduation requirements. Given that very few students take any advanced math courses before grade 9, and that most students take math courses in sequential order starting with algebra I–level courses at the rate of one per year, all students would take at least one of the advanced-level courses during one of the four years they were enrolled in high school in order to meet the new graduation requirements. Using this assumption, an estimate of the additional demand is 25 percent of grade 9–12 students enrolled in school but not currently enrolled in advanced math courses (in 2006/07 and 2007/08). A minimum of 25 percent was used because it was assumed that across their four high school years, students would need to enroll in at least one advanced math course. Therefore, in any given year, it was assumed that at least one quarter of the total grade 9–12 students would need to be enrolled in such a course.

$$\text{Additional demand} = .25\,(\text{total grade 9–12 student population} - \text{current demand})$$

(CONTINUED)

BOX 1 (CONTINUED)

Data and methodology

- New demand. The grade 9–12 student demand for advanced-level courses that will occur as a result of the new graduation requirements. New demand was calculated by adding current demand and additional demand.

$$\text{New demand} = \text{additional demand} + \text{current demand}$$

Next, student demand for increased advanced math courses was compared with advanced math–endorsed teacher availability (in 2006/07 and 2007/08) to determine the percentage of students who would have access to teachers with advanced math endorsements (access relative to need). To determine access relative to need, a measure of grade 9–12 students per advanced math–endorsed teacher was needed. Because the data do not provide a direct link between students and teachers, individual math classes (or sections) were used to calculate student access to advanced math–endorsed teachers. Assumptions and intermediate calculations described below allowed the number of students who have access to advanced math–endorsed teachers to be compared with the number of students who will need access once the new requirements are in place.

- Class sections taught per advanced math–endorsed teacher. Class sections taught per advanced math–endorsed teacher refers to the number of advanced math class sections that a teacher with an advanced math endorsement taught. To calculate this, the total number of advanced math class sections taught by advanced math–endorsed teachers was divided by the total number of advanced math–endorsed teachers.

$$\frac{\text{Number of advanced math class sections taught by advanced math–endorsed teachers}}{\text{Total number of advanced math–endorsed teachers}}$$

- Grade 9–12 students per advanced math class section. The number of grade 9–12 students enrolled in an advanced math class section. To calculate the number of grade 9–12 students per advanced math class section, the total number of grade 9–12 students enrolled in an advanced math class section was divided by the total number of advanced math class sections that were taught by teachers of any endorsement type. All math-endorsed teachers were included in this calculation to determine how many students are in each class section (some teachers were teaching advanced math classes without an advanced math endorsement).

$$\frac{\text{Number of grade 9–12 students enrolled in advanced math class sections}}{\text{Total number of advanced math class sections taught by teachers with any endorsement}}$$

- Grade 9–12 student access to an advanced math–endorsed teacher. The total number of grade 9–12 students that have access to a single advanced math–endorsed teacher. This was computed by multiplying students per advanced math class section by class sections taught per advanced math–endorsed teacher, and then taking this figure and multiplying it by the total number of advanced math–endorsed teachers (the formula below is simplified for clarity).

$$(\text{Number of students per advanced math class section} \times \text{class sections taught per advanced math–endorsed teacher}) \times \text{advanced math–endorsed teachers}$$

- Access relative to need. The percentage of students who would have access to advanced math–endorsed teachers. This was computed by dividing student access to advanced math–endorsed teachers by the new demand computed above.

$$\frac{\text{Number of students with access to an advanced math–endorsed teacher}}{\text{New demand}}$$

Finally, four model estimates were included to account for whether students took courses up to the level of geometry to meet the new requirements, took courses beyond the level of geometry to meet the new requirements, dropped out of high school, and were exempt from the new graduation requirements if they were pursuing an alternative diploma. See appendix A for details.

Note

1. There could be additional math-endorsed teachers in Oregon not teaching math classes in the years studied.

The data, obtained from one national and four state databases, were aggregated to the school level, merged, and then averaged across the two study years. The study included 527 schools with 180,505 grade 9–12 students enrolled in high school–level math classes and 3,182 teachers teaching high school–level math classes to students of any grade level.

The findings were based on two assumptions: that all grade 9 students enrolled in math courses below the algebra I level are on track to meet the new requirements if they complete three courses at or above the algebra I level in grades 10–12 (for a total of four years of high school–level math) and that it is sufficient for students to complete two courses at the algebra I level and then the required geometry course to meet the new graduation requirements.[3]

STUDY FINDINGS

In 2006/07 and 2007/08, at least 11 percent of grade 9–12 students would have been off track to meet the graduation requirements for the class of 2014 and beyond had the requirements been in place. Compared with other subcategories within each school type, small schools, schools in towns, schools with a high racial/ethnic minority population, and schools with a high population eligible for free or reduced-price lunch had the greatest proportion of grade 9–12 students off track to meet the new requirements.

Depending on the model used to estimate demand for advanced math–endorsed teachers, 62–80 percent of grade 9–12 students in 2006/07 and 2007/08 would have had access to advanced math–endorsed teachers under the new requirements. Grade 9–12 students in small schools would have faced a lower availability of advanced math–endorsed teachers than students in all other school size subcategories (29–47 percent); schools with a low population eligible for free or reduced-price lunch would have faced the highest (75–88 percent). Regardless of the model used, these availability gaps could be closed for nearly all schools by increasing the numbers of advanced math–endorsed teachers, sections taught, or students per class section.

Grade 9–12 students off track to meet Oregon's new graduation requirements, overall

Had the math graduation requirements for the class of 2014 and beyond been in place during 2006/07 and 2007/08, at least 11 percent of grade 9–12 students would have been off track to meet them.

Grade 9–12 students off track to meet Oregon's new graduation requirements, by school variable

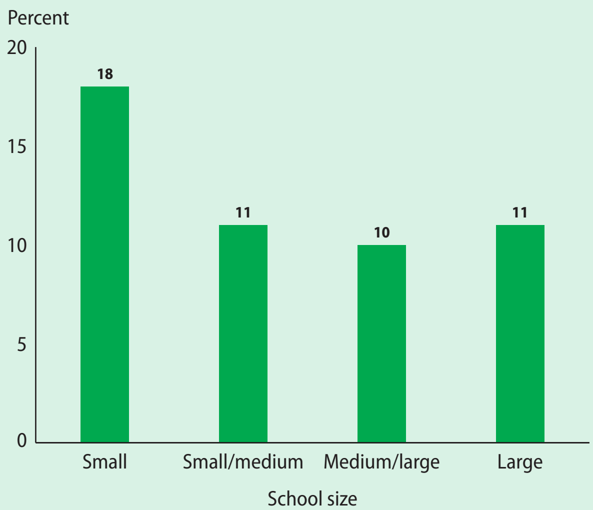
Variation by school size. Small schools have the greatest proportion (18 percent) of grade 9–12 students who would have been off track to meet the new graduation requirements had the requirements been in place during 2006/07 and 2007/08 (figure 1). Small/medium and large schools have the next greatest proportion (each at 11 percent), and medium/large schools have the smallest (10 percent). See appendix F for tables showing the number and percentage of grade 9, 10, 11, and 12 students enrolled in each of the five course content levels—by school size, locale, racial/ethnic minority population, and population eligible for free or reduced-price lunch. These tables were included because averaging across schools could mask the possibility that the proportion of students not on track by school is highly variable.

Variation by school locale. Schools in towns have the greatest proportion (14 percent) of grade 9–12 students who would have been off track to meet the new graduation requirements had the requirements been in place during 2006/07 and 2007/08 (figure 2). Schools in suburbs have the next greatest proportion (13 percent), followed by rural schools (10 percent) and city schools (9 percent).

Variation by school racial/ethnic minority population. Schools with a high racial/ethnic minority population have the greatest proportion (15 percent) of grade 9–12 students who would have been off track to meet the new graduation requirements had the requirements been in place during

FIGURE 1

Percentage of Oregon grade 9–12 students who would have been off track to meet the new graduation requirements, by school size, 2006/07 and 2007/08



Note: All grade 9 students enrolled in math were considered to be on track, including those in below algebra I–level courses (44 percent in small schools, 36 percent in small/medium schools, 33 percent in medium/large schools, and 31 percent in large schools). Also, 45 percent of grade 9–12 students in small schools, 35 percent in small/medium schools, 33 percent in medium/large schools, and 28 percent in large schools were not enrolled in high school–level math. Their likelihood of not being on track cannot be determined from the data. Totals were averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE 2

Percentage of Oregon grade 9–12 students who would have been off track to meet the new graduation requirements, by school locale, 2006/07 and 2007/08

Note: All grade 9 students enrolled in math were considered to be on track, including those in below algebra I–level courses (30 percent in rural schools, 45 percent in town schools, 32 percent in suburb schools, and 22 percent in city schools). Also, 32 percent of grade 9–12 students in rural schools, 37 percent in town schools, 23 percent in suburb schools, and 27 percent in city schools were not enrolled in high school–level math. Their likelihood of not being on track cannot be determined from the data. Totals were averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

2006/07 and 2007/08 (figure 3). Schools with a low, low/medium, and medium/high population of racial/ethnic minority students have a similar proportion, at 10 percent each.

Variation by school population eligible for free or reduced-price lunch. Schools with a high population eligible for free or reduced-price lunch have the greatest proportion (16 percent) of grade 9–12 students who would have been off track to meet the new graduation requirements had the requirements been in place during 2006/07 and 2007/08 (figure 4). Schools with a low/medium population eligible for free or reduced-price lunch (12 percent) and a medium/high population eligible for free or reduced-price lunch (13 percent) have similar proportions of students off track. Schools with a low population eligible for free or reduced-price lunch have the smallest proportion (9 percent).

Advanced math–endorsed teachers available to meet increased demand for advanced math courses, overall

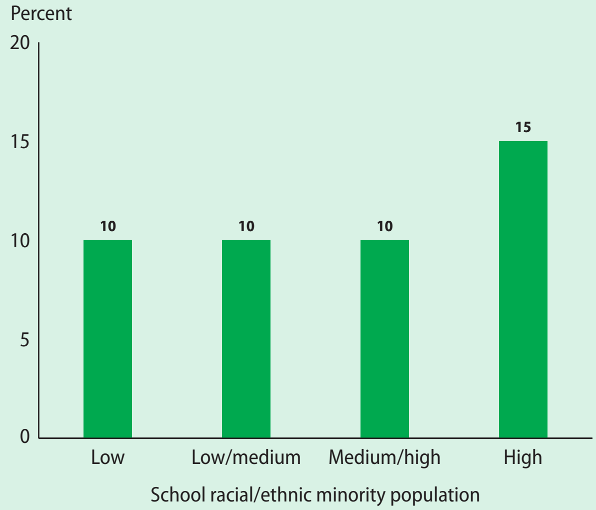
Depending on the model used to estimate demand for advanced math–endorsed teachers, 62–80 percent of grade 9–12 students needing to take advanced math courses in 2006/07 and 2007/08 would have had access to advanced math–endorsed teachers under the new graduation requirements (table 2).

Advanced math–endorsed teachers available to meet increased demand for advanced math courses, by school variable

Variation by school size. Small schools would have had the lowest percentage of grade 9 students with access to advanced math–endorsed teachers relative to need (29–47 percent); large schools would have had the highest (66–84 percent; figure 5). See

FIGURE 3

Percentage of Oregon grade 9–12 students who would have been off track to meet the new graduation requirements, by school racial/ethnic minority population, 2006/07 and 2007/08

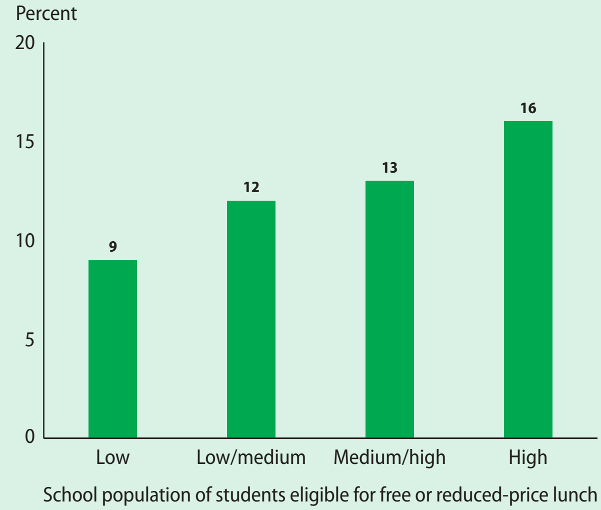


Note: All grade 9 students enrolled in math are considered to be on track, including those in below algebra I–level courses (30 percent in low–racial/ethnic minority schools, 36 percent in low/medium–racial/ethnic minority schools, 28 percent in medium/high–racial/ethnic minority schools, and 22 percent in high–racial/ethnic minority schools). Also, 37 percent of grade 9–12 students in low–racial/ethnic minority schools, 22 percent in low/medium–racial/ethnic minority schools, 25 percent in medium/high–racial/ethnic minority schools, and 29 percent in high–racial/ethnic minority schools were not enrolled in high school–level math. Their likelihood of not being on track cannot be determined from the data. Totals were averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE 4

Percentage of Oregon grade 9–12 students who would have been off track to meet the new graduation requirements, by school FRPL-eligible population, 2006/07 and 2007/08



Note: All grade 9 students enrolled in math are considered to be on track, including those in below algebra I–level courses (22 percent in schools with a low population eligible for free or reduced-price lunch, 36 percent in schools with a low/medium population eligible for free or reduced-price lunch, 38 percent in schools with a medium/high population eligible for free or reduced-price lunch, and 40 percent in schools with a high population eligible for free or reduced-price lunch). Also, 25 percent of grade 9–12 students in schools with a low population eligible for free or reduced-price lunch, 33 percent in schools with a low/medium population eligible for free or reduced-price lunch, 30 percent in schools with a medium/high population eligible for free or reduced-price lunch, and 35 percent in schools with a high population eligible for free or reduced-price lunch were not enrolled in high school–level math. Their likelihood of not being on track cannot be determined from the data. Totals were averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE 2

Estimated access to advanced math–endorsed teachers relative to need for grade 9–12 students

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	180,505	26,332	26,998	11,980	18,794	18,128	0	102,233	1,490	1.9	22.1	63,100	62
2	180,505	26,332	26,998	11,980	18,794	0	0	84,104	1,490	1.9	22.1	63,100	75
3	173,429	26,332	26,998	11,980	17,025	0	0	82,335	1,490	1.9	22.1	63,100	77
4	158,844	26,332	26,998	11,980	13,379	0	0	78,689	1,490	1.9	22.1	63,100	80

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative degree).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

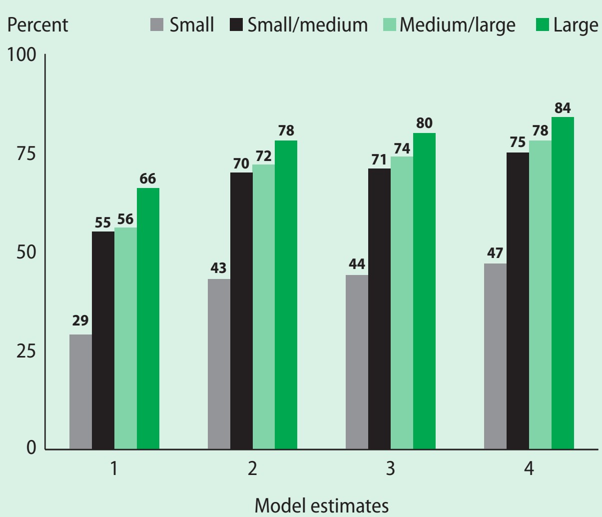
appendix G for the computations of students per class section and number of sections taught per advanced math–endorsed teacher for each school variable subcategory and for model estimates for percentage access relative to need (models 1–4) for each subcategory. See tables G1–G4 in appendix G for the output for all the models for the school size subcategories.

Variation by school locale. Schools in towns would have had the lowest percentage of grade 9–12 students with access relative to need (49–70 percent); schools in cities would have had the highest (70–87 percent; figure 6). See tables G5–G8 in appendix G for the output for all the models for the school locale subcategories.

Variation by school racial/ethnic minority population. Schools with a low–, low/medium–, and high–racial/ethnic minority population would have had a similar percentage of grade 9–12 students with access relative to need (56–79 percent; figure 7). Schools with a medium/high population of racial/ethnic minority students would have had the highest (71–87 percent). See tables G9–G12 in appendix G for the output for all the models for the school racial/ethnic minority population subcategories.

FIGURE 5

Percentage of grade 9–12 students with access to advanced math–endorsed teachers relative to need, by school size, 2006/07 and 2007/08

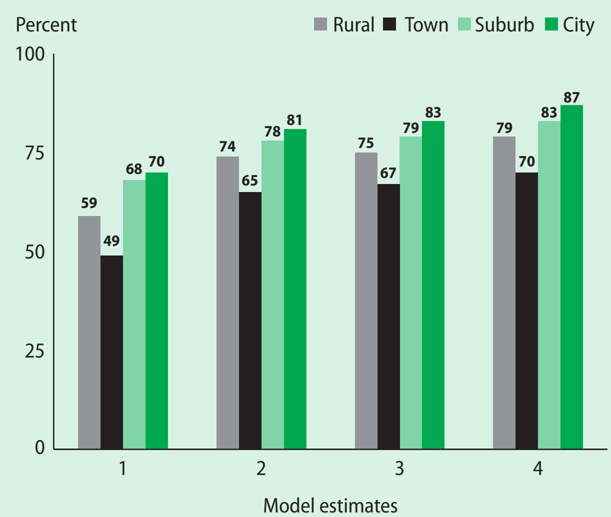


Note: Need is the number of grade 9–12 students, current demand for advanced math courses, additional demand for advanced math courses as a result of the new graduation requirements, and whether students take one or two advanced math courses to meet the requirements. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE 6

Percentage of grade 9–12 students with access to advanced math–endorsed teachers relative to need, by school locale, 2006/07 and 2007/08

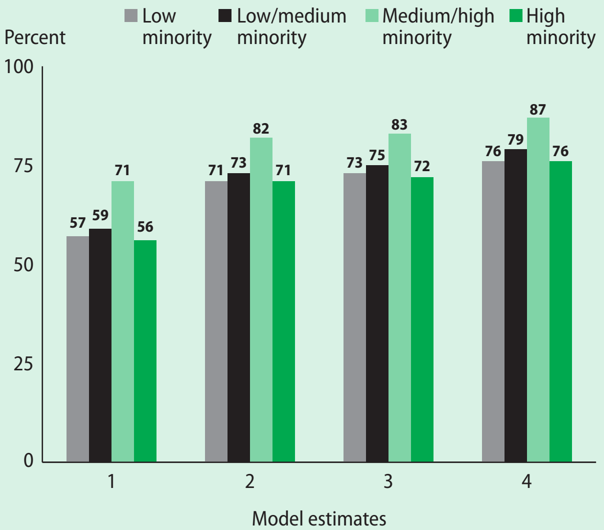


Note: Need is the number of grade 9–12 students, current demand for advanced math courses, additional demand for advanced math courses as a result of the new graduation requirements, and whether students take one or two advanced math courses to meet the requirements. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE 7

Percentage of grade 9–12 students with access to advanced math–endorsed teachers relative to need, by school racial/ethnic minority population, 2006/07 and 2007/08

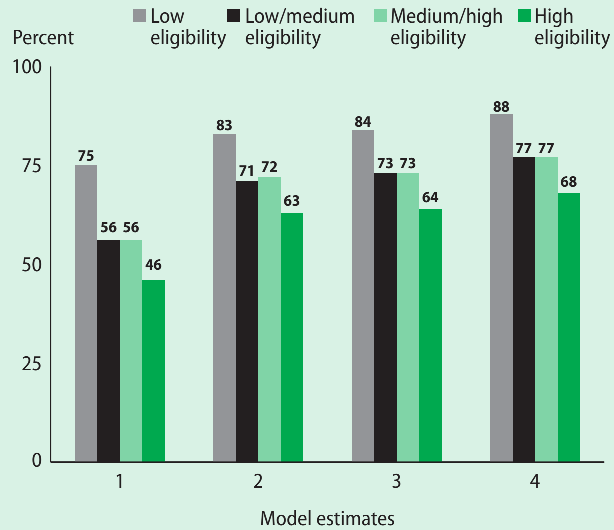


Note: Need is the number of grade 9–12 students, current demand for advanced math courses, additional demand for advanced math courses as a result of the new graduation requirements, and whether students take one or two advanced math courses to meet the requirements. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE 8

Percentage of grade 9–12 students with access to advanced math–endorsed teachers relative to need, by school population eligible for free or reduced-price lunch, 2006/07 and 2007/08



Note: Need is the number of grade 9–12 students, current demand for advanced math courses, additional demand for advanced math courses as a result of the new graduation requirements, and whether students take one or two advanced math courses to meet the requirements. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

Variation by school population eligible for free or reduced-price lunch. Schools with a high population eligible for free or reduced-price lunch would have had the lowest percentage of grade 9–12 students with access relative to need (46–68 percent); schools with a low population eligible for free or reduced-price lunch would have had the highest (75–88 percent; figure 8). See tables G13–G16 in appendix G for the output for all the models for the school population eligible for free or reduced-price lunch subcategories.

Estimates for meeting new demand. Additional model estimates were conducted for each school variable subcategory to determine what changes would ensure that 100 percent of students needing to take advanced math classes would have access to advanced math–endorsed teachers. The estimates, based on models 1 and 4 (see appendix A), examine how many more advanced math–endorsed teachers would be needed, how many more class sections would the currently available advanced math–endorsed teachers have to teach, and how many more students per class section would be needed to reach 100 percent access (see appendix H for details).

STUDY LIMITATIONS

This study has at least five limitations. First, the Oregon Department of Education's datasets are not linked to unique student identifiers. Without longitudinal data, many assumptions had to be made to investigate the research questions. This study examined snapshots of student enrollment provided over the two most recent consecutive school years with these data available (the best available analytic method at the time).

Second, class size and staff assignment data could not be merged at the class section level due to coding inconsistencies (see appendix A), forcing researchers to merge data at the school level only, which allowed for estimates but not for exact computations.

Third, the estimates used for the percentage of dropouts and the percentage of students receiving alternative diplomas were based on data from years other than those studied. The actual percentages in the years studied might vary.

Fourth, the study relied on course titles from the National Center for Education Statistics to represent the content of math courses taught in Oregon. Although these titles might not fully represent Oregon's curricula, the new Oregon math graduation requirements are also based on course titles—the only available measure of math content delivered in classes taught across the state. Further, the analyses are based on the assumptions that students take courses in order (algebra I, geometry, algebra II/trigonometry). But students could take an integrated math sequence (both geometry and algebra in grade 9). Integrated math courses, as well as core and interactive math courses, should not be coded as algebra I and above because taking one of these courses for one school year does not cover all the content in the algebra I graduation requirement. Still, some schools are considering ways to award algebra I–level graduation credit for integrated math courses (personal communication, Paul Hibbard, former Oregon Department of Education math specialist).

Additionally, if a student took more than one integrated math course, he or she might cover the algebra I or geometry requirements. The data did not allow the study team to ascertain which schools counted integrated math courses for high school credit, nor could the team determine the other courses students in these courses had taken. So, some courses were coded as below algebra I when they could contribute to high school graduation (appendix I). If these courses could be counted at the algebra I level, the percentage of grade 9–12 students off track to meet the new graduation requirements drops from 11 percent to 10.

Fifth, the results were derived by averaging across schools in the same subcategory, which can mask the fact that student enrollment and access to classes taught by advanced math–endorsed teachers by school could be highly variable. This is especially important where additional models indicated that increasing the number of advanced math–endorsed teachers, sections taught, or students per class section could close the gaps in availability of advanced math–endorsed teachers for nearly all schools. Even if these gaps could be closed for specific school subcategories, individual schools within the subcategories might be below the average.

APPENDIX A DATA AND METHODOLOGY

This appendix details the study's data sources and methodology.

Data sources

Data on student enrollment, teacher endorsements, and school demographics were obtained from five databases:

- The Oregon Department of Education class size collections (2006/07 and 2007/08) include a record for every class section taught in Oregon schools, by grade level and subject area, for each school year (Oregon Department of Education 2007a, 2008a). Class sections with the same course title (for example, multiple algebra I classes in a school) have separate records. The number of students enrolled in each class section is recorded by grade. The study team attempted to adjust for students that earn alternative diplomas (including both special education and non–special education students), which exempts them from the high school–level math coursework requirement.

- The Oregon Department of Education aggregated student membership collections (2006/07 and 2007/08) include (by grade level) the number of students enrolled at each school, the number of students at each school eligible for free or reduced-price lunch, and the number of racial/ethnic minority students at each school for each school year (Oregon Department of Education 2007b, 2008b).

- The Common Core of Data school locale codes (2006/07) include the school identification number, school name, and urban-centric locale code for each school in 2006/07, the most recent year available in the study timeframe. The locale code classifies each school into four categories, each with three subcategories, defined by the school's distance from an urban area (U.S. Department of Education 2007).

- The Teacher Standards and Practices Commission endorsement collection (2008) includes all teachers with an Oregon teaching license. Regularly merged with Oregon Department of Education data collections using a unique Oregon teacher identification number shared among the datasets, this collection contains subject-area endorsements of current and past teachers, including expiration dates of both the license (such as standard teaching) and the endorsement (basic math, for example). The current study included only teachers who taught a high school math course in 2006/07 or 2007/08 (Oregon Department of Education 2008c).

- The Oregon Department of Education staff assignment collections (2006/07 and 2007/08) include a record for each class taught in Oregon schools, by grade level and subject area, in 2006/07 and 2007/08. Classes with the same course title (such as multiple algebra I classes in a high school) have separate records. The teacher assigned to each class is recorded using a unique identification number (Oregon Department of Education 2007c, 2008d).

These datasets cover the two most recent consecutive school years with available student enrollment data for high school math courses. "High school math" courses are offered for secondary-level credit and described by the course codes developed by the National Center for Education Statistics and used by the Oregon Department of Education. Two consecutive years were chosen because the Oregon Department of Education reported that some advanced math courses (all full-year courses) are offered every other year. The data were averaged across the two years to provide a clearer snapshot of course enrollment and teacher endorsement for high school math courses.

Data organization

Preparing the data for analysis required four phases of data organization: obtaining student math course enrollment information, obtaining teacher endorsement information, obtaining school demographic information, and merging student enrollment, teacher endorsement, and school demographic information.

Phase one: obtaining student enrollment in math course information. Information on student enrollment in high school–level math courses was collected from the Oregon Department of Education class size collections for 2006/07 and 2007/08. These collections provide student enrollment numbers in each class section, by grade level, for all Oregon schools. Only schools with students of any grade enrolled in a high school–level math class (as defined by the National Center for Education Statistics course codes) were extracted to determine the number of schools to include in the study. The collections treat multiple courses with the same course title (such as multiple sections of algebra I in a high school) as separate records. Based on communications with the Oregon Department of Education math specialist about the course descriptions, class sections were categorized in one of five course content levels:

- Below algebra I.
- Algebra I (algebra I up to, but not including, geometry level).
- Geometry (geometry up to, but not including, algebra II/trigonometry level).
- Algebra II/trigonometry (algebra II/trigonometry up to, but not including, precalculus level).
- Precalculus and above.

These data were aggregated to the school by grade and by course content level, resulting in a database with math enrollment numbers for all Oregon schools with students enrolled in high school–level math during 2006/07 and 2007/08. Grade 9–12 student enrollment (grade 9–12 enrollment); all other students enrolled—for example, GED, middle-school level, or unknown grade—(other grade enrollment); and total number of students enrolled (all-grade enrollment) were then computed for each course content level and school year. The totals for each grade and course content level were averaged across the two school years. Where there was no grade 9–12 student enrollment, true zeros were used as totals only when the school was in operation for the respective year or was designated as a school enrolling grade 9–12 students.

Phase two: obtaining teacher endorsement information. Information on teacher endorsements was collected from the Teacher Standards and Practices Commission endorsement collection and Oregon Department of Education staff assignment collection. The endorsement of each teacher was coded as one of four endorsement types: advanced math, basic math, multiple subjects, or no math (table A1).

These data were aggregated so that each case depicted the highest endorsement category for each teacher. So that the endorsement type could be matched to each high school–level math course taught during 2006/07 and 2007/08, the aggregated Teacher Standards and Practices Commission endorsement collection was merged into the Oregon Department of Education staff assignment collection. Similar to the class size collection, the staff assignment collection treats

TABLE A1

Endorsement type and authorized course content level

Endorsement type	Authorized course content level
Advanced math	Any high school–level math course
Basic math	High school–level math courses up to and including algebra I level only
Multiple subjects	No high school–level math courses
No math	No high school–level math courses

Note: Endorsements are considered to be sequential, with advanced math being “higher” than basic math, basic math being “higher” than multiple subjects, and multiple subjects being “higher” than no math endorsement. Results for the multiple-subjects endorsement and the no math endorsement were combined into the category “no high school–level math endorsement.”

Source: Teacher Standards and Practices Commission of Oregon 2009.

multiple courses with the same course title as separate records. Two new variables were then created: one identifying each class section as in one of the five content levels and one indicating whether the class section was taught by a properly endorsed teacher—a teacher with the endorsement required to teach that particular course (see table A1).

The data were then aggregated to the school by course content level to build a database that for each school and year consisted of the number of teachers with each endorsement type, the number of class sections taught in each course content level, the number of courses taught by properly endorsed teachers in each course content level, and the number of class sections taught by properly endorsed teachers in each course content level. The totals were then averaged across the two school years. Where there were no class sections taught, true zeros were used as totals only when the school was in operation for the respective year, the school was designated as a school enrolling grade 9–12 students, or there were student enrollment counts for the variable.

Ideally, the teacher endorsement information would have been merged with the student enrollment information (phase one) at the class section level (before aggregating to the school level), so that student enrollment could be linked to the endorsement of the teacher who taught the class. This would have required matching the Oregon Department of Education staff assignment and class size collections on the course code, class period, and class location for each school. However, these collections have separate business rules for data entry: the staff assignment collection requires high school–level math classes (such as algebra I) taught at middle schools to be coded using the National Center for Education Statistics course code, but this was not a specified business rule for the class size collection. Therefore, algebra I taught at a middle school was likely coded as 2031 in the staff assignment collection but as 9071, or "middle school math," in the class size collection. Circumventing this issue by matching solely on class period and class location was impossible because neither had standard coding. For example, in the staff assignment collection, the period was listed as P1 and the location as Room 1, but in the class size collection, the period was listed as Period 1 and the location as "Smith." Approximately 20 percent of cases could not be matched, and 25 percent of these cases were in schools that systematically differed from the matching cases. (For example, schools with 50 percent or greater unmatched records were much smaller than schools with 50 percent or greater matched records.)

Phase three: obtaining school demographic information. School demographic data were obtained from the Oregon Department of Education student membership collections (2006/07 and 2007/08) and Common Core of Data school locale codes (2006/07). Of interest were the school locale codes, student enrollment in school by grade, number of racial/ethnic minority (non-White, including Hispanic) students enrolled in each school, and the number of students eligible for free or reduced-price lunch in each school. While this study focuses on grade 9–12 student enrollment in high school–level math courses, some of the schools extracted from the class size and staff assignment collections had students of other or unspecified grade levels enrolled in high school math courses. As a result, the number of students in all grades (not just in grades 9–12) was of interest for defining the demographic of the school. The totals from the Oregon Department of Education student membership collections were then averaged across the two school years. Where there was no student enrollment, true zeros were used as totals for the respective year only when the school was in operation for the respective year or was designated as a school enrolling grade 9–12 students.

Of the 565 schools that had students enrolled in high school–level math courses, 38—predominately small alternative schools—were excluded from the analysis due to missing data for at least one school variable. The 527 remaining schools were coded into one of four categories for each of the four school variables:

- *School size.* The total number of students (all grade levels) enrolled in the school was used to define school size. Quartiles were used to define schools as small, small/medium, medium/large, or large. (The Oregon Department of Education requested that the study use quartiles so that the results would align with other data analyzed by the department.)

- *School locale.* The four main categories of the ulocale code variable from the 2006 Common Core of Data were used to define schools as rural, town, suburb, or city.

- *School racial/ethnic minority population.* The total number of non-White (including Hispanic) students (all grade levels) enrolled in the school was divided by the total number of students in school to get the percentage of racial/ethnic minority students enrolled in the school. Quartiles were used to define schools as low–, low/medium–, medium/high–, or high–racial/ethnic minority.

- *School population eligible for free or reduced-price lunch.* The total number of students eligible for free or reduced-price lunch (all grade levels) was divided by the total number of students in school to get the percentage of students enrolled in the school eligible for free or reduced-price lunch. Quartiles were used to define schools as low–, low/medium–, medium/high–, or high–population eligible for free or reduced-price lunch.

Phase four: merging student enrollment, teacher endorsement, and school demographic information. For the final phase, the databases created in the first three phases were merged into one school-level database containing information on student enrollment by grade; student enrollment in each of the five high school–level math course content levels by grade; the number of teachers with each endorsement type; the number of courses and class sections taught in the course content levels; the number of class sections taught by teachers properly endorsed to teach in the course content levels; and the subcategories for school size, locale, racial/ethnic minority student population, and population eligible for free or reduced-price lunch. See appendix C for the number of valid cases for each subcategory of each school variable.

Preliminary analysis

The 527 schools included in the study enrolled 294,244 students, 180,505 of them in grades 9–12. Table C2 in appendix C shows the dispersion of school enrollment across the four subcategories of each school type. Of the 180,505 grade 9–12 students, 126,552 were enrolled in high school–level math classes. Tables C4–C7 in appendix C show the dispersion of the math enrollment by course content level across the four subcategories of school type. Those students were taught by 3,182[4] teachers in 8,344 math class sections. Figure D1 in appendix D shows the dispersion of the number of teachers teaching high school–level math, and figure E1 in appendix E shows the dispersion of the class sections taught across the four subcategories of school type. Of the 3,182 teachers, 2,309 had either the basic or advanced math endorsement, and 873 were not endorsed to teach high school math. Figure D2 in appendix D displays teacher endorsements disaggregated by endorsement type. (See appendixes C–E for the results of the preliminary analysis, conducted to provide context for the findings.)

Main analysis

Two stages guided the main analysis: calculating the number of students who would have been off track to graduate had the requirements been in place during the study years and determining the increased demand for advanced math–endorsed teachers stemming from the requirements.

Calculating the number of students off track. Before the number of off-track students could be calculated, the students had to be identified. This required computing the percentage of students enrolled in each course content level at each school for grades 9, 10, 11, and 12 by dividing the enrollment at that level and grade across the two study years by the total number of students enrolled in that grade (table A2). Students were defined as on track if enrolled in at least one algebra I–level course in grade 10. Grade 10 students enrolled in below algebra I–level courses would not have been on track because even if they had completed the course and then completed an algebra I or higher level course in grade 11 or 12, they would have taken only two years of math at the level of algebra I and above by the end of grade 12. Grade 11 or 12 students enrolled in below algebra I–level courses would not have been on track for the same reason.

The likelihood that grade 9 students enrolled in below algebra I–level courses would not be on track to meet the requirements could not be ascertained from these data. They would be on track if they passed their below algebra I–level course and then continued in math for three more years at the algebra I and above level. Therefore, all grade 9 students were considered to be on track. Note, however, that grade 9 students in below algebra I–level courses would have to pass four full years of math classes to meet the new requirements. If they failed to pass any of these courses, they would no longer be on track.

To calculate the proportion of students not on track, the total number of grade 9–12 students identified as not on track to meet new graduation requirements had they been in place during the years studied was divided by the total number of grade 9–12 students (the number of grade 10, 11, and 12 students enrolled in below algebra I–level courses divided by the number of grade 9, 10, 11, and 12 students enrolled in school). Out of 180,505 grade 9–12 students enrolled in school, 126,552 (70 percent) were enrolled in math courses. The remaining 30 percent were not identified as being not on track. (However, the proportion of students not enrolled in math by grade is included in the tables.) Although it is unknown why 30 percent of grade 9–12 students were not enrolled in math courses, analyses revealed that slightly less than three-quarters of these students were in grades 11 or 12, suggesting that many of these students had already fulfilled the two-math-course requirement in place when they were in high school or that they had an individualized education program exempting them from high school–level math courses.

TABLE A2
Oregon student enrollment in math by grade and course content level, 2006/07 and 2007/08

Course content level	Grade 9		Grade 10		Grade 11		Grade 12	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Below algebra I	14,812	32	11,037	24	6,673	15	2,899	7
Algebra I	15,109	33	6,781	15	3,004	7	929	2
Geometry	7,443	16	11,240	24	5,727	13	1,923	4
Algebra II/ trigonometry	1,678	4	8,087	18	11,049	25	6,185	14
Precalculus and above	151	0	1,106	2	5,200	12	5,524	13
No math	6,831	15	7,891	17	13,061	29	26,171	60
Total school population	46,023	100	46,141	100	44,713	100	43,629	100

Note: Percentages were averaged across 2006/07 and 2007/08 and rounded to whole numbers. Therefore, the sum of the disaggregated results might not equal that of the aggregated results. To calculate the percentage for each grade, the number of students enrolled in the respective course content level was divided by the total number of students.

Source: Authors' computations using a dataset generated from multiple sources described in this appendix.

Determining increased demand. The new graduation requirements could increase demand for advanced math courses, and this increased demand will likely affect the need for teachers with advanced math endorsements. These assumptions are based on the availability of these teachers during the 2006/07 and 2007/08 school years. Because not all teachers teaching advanced math courses have an advanced math endorsement, the calculations require pulling out the number of sections taught by advanced math–endorsed teachers from the number of sections taught by teachers with any type of endorsement.

To determine this new demand, the following assumptions and calculations were made:

- *Current demand.* The number of grade 9–12 students enrolled in geometry-level, algebra II/trigonometry–level, and precalculus-level courses in 2006/07 and 2007/08.

- *Additional demand.* The number of additional grade 9–12 students who would need to take at least one advanced math course during high school to meet the new graduation requirements. Given that very few students take any advanced math courses before grade 9 and that most high school students take one math course per year beginning at the algebra I level, all students would need to take at least one advanced math course in high school to meet the new graduation requirements. Using this assumption, an estimate of the additional demand is 25 percent of grade 9–12 students enrolled in school but not in an advanced math course (in 2006/07 and 2007/08). A minimum of 25 percent was used because it was assumed that across four years of high school, students would need to enroll in at least one advanced math course—that in any given year at least a quarter of grade 9–12 students would need to be enrolled in such a course.

  Additional demand = .25 (total grade 9–12 student population – current demand)

- *New demand.* The grade 9–12 student demand for advanced math courses that will result from the new graduation requirements. New demand was calculated by adding current demand and additional demand.

  New demand = additional demand + current demand

Next, increased demand for advanced math courses was compared with advanced math–endorsed teacher availability to determine the percentage of students who would have had access to teachers with advanced math endorsements (access relative to need). Because the data do not provide a direct link between students and teachers, individual math class sections were used to calculate student access to advanced math–endorsed teachers. Four assumptions and intermediate calculations allowed the number of students who have access to advanced math–endorsed teachers to be compared with the number of students who will need access once the new math requirements are in place:

- *Class sections taught per advanced math–endorsed teacher.* The number of advanced math class sections taught by advanced math–endorsed teachers divided by the total number of advanced math–endorsed teachers.

$$\frac{\text{Number of advanced math class sections taught by advanced math–endorsed teachers}}{\text{Total number of advanced math–endorsed teachers}}$$

- *Grade 9–12 students per advanced math class section.* The number of grade 9–12 students enrolled in advanced math courses divided by the number of advanced math class sections taught by teachers of any endorsement type. (All math-endorsed teachers were included in this calculation because some teachers were teaching advanced math courses without an advanced math endorsement).

$$\frac{\text{Number of grade 9–12 students enrolled in advanced math class sections}}{\text{Total number of advanced math class sections taught by teachers with any endorsement}}$$

- *Grade 9–12 student access to an advanced math–endorsed teacher.* The number of grade 9–12 students with access to a single advanced math–endorsed teacher, computed by multiplying students per advanced math class section by class sections taught per advanced math–endorsed teacher, and then multiplying the product by the number of advanced math–endorsed teachers.

$$(\text{Number of students per advanced math class section} \times \text{number of sections taught per advanced math–endorsed teacher}) \times \text{number of advanced math–endorsed teachers}$$

- *Access relative to need.* The percentage of students who would have had access to advanced math–endorsed teachers, computed by dividing student access to advanced math–endorsed teachers by new demand.

$$\frac{\text{Number of students with access to an advanced math–endorsed teacher}}{\text{New demand}}$$

Student demand can depend on whether students take courses up to or beyond the level of geometry to meet the new requirements; whether students drop out of high school; and whether students pursuing an alternative diploma, including special education and non–special education students, are exempt from the new graduation requirements —a decision made by districts based on eligibility criteria and timeframes (personal communication, Mark Freed, Oregon Department of Education math education specialist). To account for these factors, four model estimates were included.

Model 1 assumes that all grade 9–12 students will take an algebra I–level course, a geometry-level course, and an algebra II–level course (in that order) to meet the new requirements. Model 2 assumes that the highest level of math that students need to meet the new requirements is geometry (two algebra I–level courses and one geometry-level course). Models 3 and 4 have the same course-taking assumption as model 2. In model 3, however, the number of grade 9–12 students is reduced by 3.92 percent to consider the average high school dropout rate during the two years of the study (Oregon Department of Education 2010a). And in Model 4, the number is reduced 12 percent to account for an estimate of the percentage of students who might be exempted from the new math requirements because they received an alternative diploma (Oregon Department of Education 2010b).

APPENDIX B
COURSE CODES, TITLES, AND DESCRIPTIONS BY COURSE CONTENT LEVEL

Coding of courses within the content levels was done in consultation with an Oregon Department of Education math specialist. The integrated math, core math, and interactive math courses were coded at the below algebra I level. The specialist noted that taking one of these yearlong courses did not cover all the content in the algebra I graduation requirement. Even if some districts were considering, or already implementing, ways to award graduation credit for these courses, the specialist suggested that the courses be coded at the below algebra I level.

TABLE B1
National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
Below algebra I	
2001: Core math	National Council of Teachers of Mathematics (NCTM) core math, a multiyear sequential program, emphasizes the teaching of mathematics as problem solving, communication, and reasoning. The courses emphasize the connections among mathematical topics and between mathematics and other disciplines. The first year of the core curriculum focuses on patterns and properties in mathematics and includes exploring geometric figures; exploring data; graphs; expressions, sentences, and situations; models for operations; linear situations, sentences, and graphs; products and powers; properties of geometric figures; measures in geometry; introduction to probability and simulation; and introduction to functions. The second year of the core curriculum focuses on visualizing relationships and includes variation and modeling; coordinate geometry; transformations of geometric figures; introduction to trigonometry; functions; lines, parabolas, and exponential curves; transformations of functions and data; systems; matrices; and combinatorics and binomial distributions. The third year focuses on functions and reasoning and includes fitting curves to data; circular functions and models; exponential and logarithmic functions; logic; and reasoning in geometry, algebra, intuitive calculus, discrete mathematics, probability, and statistics. The fourth year of the core curriculum (advanced math core) focuses on math for students who intend to go to college. It includes operating with and describing functions; functions and equations; circular functions; applications of matrices; complex numbers and polar coordinates; recursion; advanced proof ideas; rates and areas; statistical inference; and algebra and algorithms.
2002: Interactive math project	Interactive math project organizes the teaching of mathematics around solving substantial problems and integrates mathematics with other subject areas. The first year of the interactive curriculum is organized around five units ranging from four to seven weeks. The first year's units give students experience with working in groups to analyze problems, expressing mathematical ideas orally and in writing, using concrete mathematical models, carrying out investigations when the task is not clearly defined, and becoming familiar with alternative assessment techniques. Specifically, these units expose students to geometric and number patterns, the use of variables to express generalizations, linear relationships, mathematical models, systems of equations, expected value, probability, data analysis, quadratic equations, curve fitting, similarity, and trigonometric functions. Building on the first year, the second year's units develop symbolic representations of problems; introduce concepts of equivalent expressions equations; develop algebraic techniques and graphing; and introduce statistics, area, and volume of polygons, Pythagorean theorem, scientific notation, exponents, graphing and solving systems of linear equations, linear programming, and maximization and minimization. Two weeklong units are designed to improve students' writing and to develop strategies for solving problems similar to those found on the Scholastic Aptitude Test. Third-year units expose students to further concepts in probability, including permutations and combinations; binomial theorem; properties of Pascal's triangle; circles and coordinate geometry, including developing formulas for circumference, area, and midpoint of a line; growth models; concept of slope; matrices; and derivative, exponential, logarithmic, and circular functions.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2003: Integrated math	Integrated math courses emphasize the teaching of mathematics as problem solving, communication, and reasoning and emphasize the connections among mathematical topics and between mathematics and other disciplines. The three-year sequence of integrated math replaces the traditional algebra I, geometry, algebra II sequence of courses and usually covers the following topics during the three-year sequence: algebra, functions, geometry from both a synthetic and an algebraic perspective, trigonometry, statistics and probability, discrete mathematics, the conceptual underpinnings of calculus, and mathematical structure.
2004: Informal math integrated approach	Informal math integrated approach courses emphasize the teaching of mathematics as problem solving, communication, and reasoning and highlight the connections among mathematical topics and between mathematics and other disciplines. Unlike the three-year sequence of integrated math, which replaces the traditional algebra I, geometry, algebra II sequence, these courses apply a problem-solving approach to the teaching of general math, prealgebra, and pregeometry topics. Emphasis is on the use of numbers to analyze real-world problems, estimation, algebraic and geometric concepts and relationships, and mathematical models.
2011: Resource center math	Taught in a resource center or laboratory setting where the emphasis is on individual student progress, resource center math includes the study of general math topics, such as arithmetic, using rational numbers, numeration systems and place value, basic geometry, and basic statistics. These courses also apply these skills to real-world problems and situations.
2012: Basic math	Basic math courses emphasize attainment of basic math skills for students who have not yet mastered these skills. Basic math includes the study of general math topics, such as arithmetic using rational numbers, numeration systems and place value, basic geometry, basic statistics, and application of these skills to real-world problems and situations. Enhancement topics include area, perimeter, and volume of geometric figures; ratio and proportion; estimation; and formulas.
2013: General math	General math courses reinforce basic math skills for students who have previously attained them, and extend these skills to further applications and concepts. General math includes the study of general math topics, such as arithmetic using rational numbers, basic geometry, basic statistics, and application of these skills to real-world problems and situations. Enhancement topics include area, perimeter, and volume of geometric figures; congruence and similarity; angle relationships: the Pythagorean theorem; the rectangular coordinate system; sets and logic; ratio and proportion; estimation; formulas; solving and graphing simple equations and inequalities (that is, linear equations in one variable); and operations with real numbers.
2014: Consumer math	Consumer math courses reinforce general math skills for students who have previously attained them. They may extend the general math skills to cover additional math concepts and use these skills in a variety of consumer applications. In addition to reinforcing general math topics, such as arithmetic using rational numbers, measurement, and basic statistics, these courses apply these skills to consumer problems and situations. Applications may include budgeting, taxation, credit, banking services, insurance, buying and selling products and services, home or car ownership and rental, managing personal income, and investment. Enhancement topics include ratio and proportion, further statistical concepts (that is, measures of central tendency), and basic probability theory.
2015: Applied math general focus	These courses reinforce general math skills for students who have previously attained them. They may extend these skills to include some prealgebra and algebra topics and use these skills in a wide variety of practical, consumer, business, and occupational applications. Applied math general focus courses reinforce general mathematics topics, such as arithmetic using rational numbers, measurement, and basic statistics. Enhancement topics include ratio and proportion, exponents and radicals, area, perimeter, and volume of geometric figures, formulas, and simple equations.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2016: Applied math occupational focus	Applied math occupational focus courses reinforce general math skills for students who have previously attained them. They may extend these skills to include some prealgebra and algebra topics and use these skills primarily in a variety of occupational applications. These courses reinforce general mathematics topics, such as arithmetic using rational numbers, measurement, and basic statistics. Enhancement topics include ratio and proportion; exponents and radicals; area, perimeter, and volume of geometric figures; formulas; and simple equations.
2021: Prealgebra	Prealgebra courses are generally intended to provide an extra year of study for students who have attained general mathematics objectives but are not yet ready to enter algebra I. Prealgebra covers a variety of topics, such as properties of rational numbers (that is, number theory), ratio, proportion, estimation, exponents and radicals, the rectangular coordinate system, sets and logic, formulas, and solving first-degree equations and inequalities. Review topics include arithmetic using rational numbers, basic geometry, and basic statistics. Enhancement topics include operations involving real numbers, evaluating rational algebraic expressions, graphing first-degree equations and inequalities, translating word problems into equations, polynomial operations and factorization, and solving simple quadratics.
2022: Principles of algebra and geometry	Principles of algebra and geometry courses include the study of formulas; algebraic expressions; first-degree equations and inequalities; the rectangular coordinate system; area, perimeter, and volume of geometric figures; and properties of triangles and circles. Review topics include arithmetic using rational numbers, measurement systems, and basic statistics. Enhancement topics include operations involving real numbers, evaluating rational algebraic expressions, graphing first-degree equations and inequalities, translating word problems into equations, operations with and factoring of polynomials, and solving simple quadratics.
2023: Informal geometry	Informal geometry courses emphasize a practical, synthetic approach to the study of geometry and deemphasize an abstract, formal approach. Topics include properties of plane and solid figures, such as perimeter, area, and volume; lines, segments, angles, and circles; parallelism, perpendicularity, congruence, similarity, and proportion; and inductive methods of reasoning. Review topics include basic measurement. Enhancement topics include the Pythagorean theorem, trigonometric ratios, transformational geometry, coordinate geometry, correspondence between algebraic and geometric concepts, and deductive methods including concept of proof.
2024: Applied math CORD	Following the curriculum developed by the Center for Occupational Research and Development (CORD), these courses use a competency-based approach to the learning of general math, prealgebra, and pregeometry topics and emphasize occupationally related applications and problem-solving techniques. The 25 course units cover the following topics: estimation; measurement; working with data (including the use of graphs, charts, and tables); lines and angles; two- and three-dimensional figures; ratio and proportion; scale drawings; signed numbers and vectors; scientific notation; precision, accuracy, and tolerance; exponents and radicals; formulas; linear and nonlinear equations; statistics and probability; right-triangle relationships; and trigonometric functions.
2032: Algebra I part 1	The first year in a two-year sequence of algebra I, this course generally covers the same topics as the first semester of algebra I, including the study of properties of rational numbers (that is, number theory); ratio, proportion, and estimation; exponents and radicals; the rectangular coordinate system; sets and logic; formulas; and solving first-degree equations and inequalities. Review topics include arithmetic using rational numbers, basic geometry, and basic statistics. Enhancement topics include operations involving real numbers, evaluating rational algebraic expressions, graphing first-degree equations and inequalities, translating word problems into equations, operations with and factoring of polynomials, and solving simple quadratic equations.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2033: Algebra I part 2	The second year in a two-year sequence of algebra I, this course generally covers the same topics as the second semester of algebra I, including the study of properties of the real number system and operations, evaluating rational algebraic expressions, solving and graphing first-degree equations and inequalities, translating word problems into equations, operations with and factoring of polynomials, and solving simple quadratics. Review topics include ratio and proportion, operations with sets, simplifying radical expressions, operations with exponents, and solution of simple linear equations. Enhancement topics include field properties and theorems, set theory, solving systems of linear equations and inequalities, and solving and graphing more complex quadratic equations.
2061: Probability and statistics, algebra I level	These courses provide an introduction to probability and statistics and reinforce general math skills for students who have previously mastered general mathematics topics. The courses include the study of basic probability and statistics topics—discrete probability theory, sample space, frequency tables, graphing data, and measures of central tendency—and may use these skills in a variety of real world applications. Enhancement topics include normal curve distribution and measures of variability.
2064: Business math	This course reinforces general math skills for students who have previously attained them, emphasizes speed and accuracy in computations, may extend the general math skills to cover additional math concepts, and uses these skills in a variety of business applications. Business math reinforces general math topics such as arithmetic using rational numbers, measurement, and basic statistics. In addition, these courses apply these skills to business problems and situations; applications might include wages, hourly rates, payroll deductions, sales, receipts, accounts payable and receivable, financial reports, discounts, and interest.
Algebra I	
2031: Algebra I	Algebra I courses include the study of properties and operations of the real number system; evaluating rational algebraic expressions; solving and graphing first-degree equations and inequalities; translating word problems into equations; operations with and factoring of polynomials; and solving simple quadratic equations. Review topics include ratio and proportion, operations with sets, simplifying radical expressions, operations with exponents, and solving simple linear equations. Enhancement topics include field properties and theorems; set theory; solving systems of linear equations and inequalities; and solving and graphing more complex quadratic equations.
2062: Probability and statistics	Probability and statistics algebra I–level courses focus on descriptive statistics, with an introduction to inferential statistics. Topics include event probability, normal probability distribution, collection and description of data, frequency tables and graphs, measures of central tendency and variability, random variables, and random sampling. Enhancement topics include covariance and correlation, central limit theorem, confidence intervals, and hypothesis testing.
2065: Business math algebra I level	Intended for students who have attained algebra I objectives, these business math courses apply algebra concepts to a variety of business and financial situations. Applications include insurance, credit, banking, stocks and bonds, trusts and estates, finance, and taxation.
2068: Computer math	Intended for students who have attained the objectives of algebra I, computer math algebra I–level courses include a study of computer systems and programming and use the computer to solve math problems.
Geometry	
2034: Geometry	Geometry courses, emphasizing an abstract, formal approach to the study of geometry, include topics such as properties of plane and solid figures; deductive methods of reasoning and use of logic; geometry as an axiomatic system, including the study of postulates, theorems, and formal proofs; rules of congruence, similarity, parallelism, and perpendicularity; and rules of angle measurement in triangles, including trigonometry, coordinate geometry, and transformational geometry. Review topics include basic measurement; perimeter, area, and volume; and inductive methods of reasoning. Enhancement topics include topology, locus, and non-Euclidean geometries.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2035: Prealgebra II	Prealgebra II courses review and extend algebra and geometry concepts for students who have already taken algebra I and geometry. Prealgebra II courses include a review of such topics as properties and operations of real numbers; evaluation of rational algebraic expressions; solving and graphing first-degree equations and inequalities; translating word problems into equations; operations with and factoring of polynomials; simple quadratics; properties of plane and solid figures; rules of congruence and similarity; coordinate geometry including lines, segments, and circles in the coordinate plane; and angle measurement in triangles, including trigonometric ratios. Review topics include ratio and proportion; operations with sets; simplifying radical expressions; operations with exponents; solving simple linear equations; and perimeter, area, and volume. Enhancement topics include field properties and theorems; set theory; solving systems of linear equations and inequalities; and solving and graphing more complex quadratics.
2045: Elementary functions	Elementary functions courses, while preparing students for eventual work in calculus, include the study of relations and functions, including polynomial, logarithmic, exponential, rational, right trigonometric, and circular functions—and their inverses, graphs, and applications. Review topics include structure of the real number system. Enhancement topics include statistical and probability functions.
2046: Analytic geometry	Analytic geometry courses include the study of the nature and intersection of lines and planes in space, including vectors, the polar coordinate system, equations and graphs of conic sections, rotations and transformations, and parametric equations. Review topics include solutions of linear and quadratic equations and systems of these equations, and polynomial and rational functions and their graphs in the rectangular coordinate system. Enhancement topics include matrix algebra and analytic geometry of solids.
2047: Math analysis	Math analysis courses include the study of polynomial, logarithmic, exponential, and rational functions and their graphs; vectors; set theory; Boolean algebra and symbolic logic; mathematical induction; matrix algebra; sequences and series; and limits and continuity. Review topics include right trigonometric and circular functions and their graphs as well as other trigonometry topics. Enhancement topics include elementary probability and statistics, derivatives, and integrals.
Algebra II/trigonometry	
2041: Algebra II	Algebra II course topics include field properties and theorems; set theory; operations with rational and irrational expressions; factoring of rational expressions; in-depth study of linear equations and inequalities; quadratic equations; solving systems of linear and quadratic equations; graphing of constant, linear, and quadratic equations; properties of higher degree equations; and operations with rational and irrational exponents. Review topics include operations involving real numbers, evaluating rational algebraic expressions, solving and graphing first-degree equations and inequalities, operations with and factoring of polynomials, and solving simple quadratics. Enhancement topics include the complex number system; polynomial, logarithmic, and exponential functions, relations, and their graphs; conic sections; elementary probability and statistics; matrices and determinants; sequences; and series.
2042: Algebra III	Algebra III courses review and extend algebraic concepts for students who have already taken algebra II. Course topics include (but are not limited to) operations with rational and irrational expressions, factoring of rational expressions, linear equations and inequalities, quadratic equations, solving systems of linear and quadratic equations, properties of higher degree equations, and operations with rational and irrational exponents. The courses may introduce topics in discrete math, such as elementary probability arid statistics including binomial expansion; matrices and determinants; and sequences and series. Review topics include operations involving real numbers, evaluating rational algebraic expressions, solving and graphing first-degree equations and inequalities, operations with and factoring of polynomials, solving simple quadratics, and sets and logic. Enhancement topics include right triangle trigonometry and polynomial, logarithmic, and exponential functions, relations, and their graphs.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2043: Trigonometry	Trigonometry courses prepare students for eventual work in calculus and include the study of the following topics: trigonometric and circular functions, their inverses and graphs, relations among the parts of a triangle, trigonometric identities and equations, solutions of right and oblique triangles, and complex numbers. Enhancement topics include vectors, graphing in the polar coordinate system, and matrix algebra.
2044: Algebra II/ trigonometry	Algebra II/trigonometry courses combine topics from both of these courses for students who have attained algebra I and geometry objectives. Topics include field properties and theorems; set theory; operations with rational and irrational expressions; factoring of rational expressions; in-depth study of linear equations and inequalities; quadratic equations; solving systems of linear and quadratic equations; graphing of constant, linear, and quadratic equations; properties of higher degree equations; operations with rational and irrational exponents; right trigonometric and circular functions, inverses, and graphs; trigonometric identities and equations; solutions of right and oblique triangles; complex numbers; and numerical tables. Review topics include operations involving real numbers, evaluating rational algebraic expressions, solving and graphing first-degree equations and inequalities, operations with and factoring of polynomials, and solving simple quadratics. Enhancement topics include polynomial, logarithmic, and exponential functions and graphs; conic sections; vectors; graphing in the polar coordinate system; elementary probability and statistics; matrices and determinants; and sequences and series.
2048: Trigonometry/ analytic geometry	Covering topics of both trigonometry and analytic geometry, these courses prepare students for eventual work in calculus. Topics include the study of right trigonometric and circular functions, inverses, and graphs; trigonometric identities and equations; solutions of right and oblique triangles; complex numbers; numerical tables; vectors; the polar coordinate system; equations and graphs of conic sections; rotations and transformations; and parametric equations. Review topics include solutions of linear and quadratic equations. Enhancement topics include polynomial, logarithmic, exponential, and rational functions and their graphs; matrix algebra; and analytic geometry of solids.
2049: Trigonometry math analysis	Covering both trigonometry and math analysis topics, these courses prepare students for eventual work in calculus. Topics include the study of right trigonometric and circular functions, inverses, and graphs; trigonometric identities and equations; solutions of right and oblique triangles; complex numbers; numerical tables; polynomial, logarithmic, exponential, and rational functions and their graphs; vectors; set theory; Boolean algebra and symbolic logic; mathematical induction; matrix algebra; sequences and series; and limits and continuity. Enhancement topics include elementary probability and statistics, derivatives, and integrals.
2050: Analytic geometry math analysis	Covering topics from both analytic geometry and math analysis, these courses prepare students for eventual work in calculus. Topics include the study of polynomial, logarithmic, exponential, and rational functions and their graphs; vectors; the polar coordinate system; equations and graphs of conic sections; rotations and transformations; parametric equations; set theory; Boolean algebra and symbolic logic; mathematical induction; matrix algebra; sequences and series; and limits and continuity. Review topics include solutions of linear and quadratic equations and systems of these equations, right trigonometric and circular functions and their graphs, and other trigonometry topics. Enhancement topics include analytic geometry of solids, elementary probability and statistics, derivatives, and integrals.
2051: IB math studies	IB (International Baccalaureate) mathematical studies courses prepare students to take the IB mathematical studies exam at the subsidiary or higher level. These courses are intended to provide the skills needed to cope with the mathematical demands of a technological society. Course topics include linear, quadratic, and exponential functions, solutions, and graphs; skills in computation, estimation, and development of algorithms; data analysis, including collection, calculation, and presentation of statistics; set operations and logic; business techniques, including progressions and linear programming; and geometry and trigonometry. Enhancement topics include numerical functions, variation properties, financial mathematics, critical path analysis, model building, and multidimensional geometry.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2052: IB mathematics	IB mathematics courses prepare students to take the IB mathematical studies exam at either the subsidiary or higher levels. Topics include operations and properties of number sets; trigonometric functions, equations, and graphs; algebra and coordinate geometry; simultaneous linear equations; polynomial and quadratic functions and equations; calculus, including bilinear, exponential, and logarithmic functions; two dimensional vectors and matrices; and probability. Enhancement topics include analysis and numerical calculation; analytical geometry; further calculus, including integration; complex numbers; statistics; and two-dimensional particle dynamics.
2063: Probably and statistics	Probability and statistics algebra II–level courses emphasize both descriptive and inferential statistics. Topics include event probability; probability distributions including binomial and normal distributions; analysis of data; measures of central tendency and variability; random variables; random sampling; central limit theorem; confidence intervals; and hypothesis testing. Enhancement topics include nonparametric statistics, multinomial theorem and chi-square tests, ordinary least squares, and simple regression.
2066: Business math algebra II level	Intended for students who have attained the objectives of algebra II, business math algebra II–level courses apply algebra concepts to a variety of business and financial situations.
2069: Computer math algebra II level	Intended for students who have attained the objectives of algebra II, computer math algebra II–level courses include a study of computer systems and programming and use the computer to solve math problems.
2071: IB mathematics and computing SL	IB mathematics and computing SL courses prepare students to take the IB mathematics and computing exam at the subsidiary level. Designed to give students a working knowledge of a high-level programming language developed in the context of sound mathematical training, the course includes the following topics: operations and properties of number sets; trigonometric functions, equations, and graphs; algebra and coordinate geometry, including simultaneous linear equations, binomial theorem, and polynomial and quadratic functions and equations; calculus, including bilinear, exponential, and logarithmic functions; vectors and matrices; and numerical analysis. The courses also contain components on computer problem solving and programming and on topics regarding computer hardware, software, modes of operation, and data types and structures.
2072: History of math algebra II level	Intended for students who have attained the objectives of algebra II, history of math algebra II–level courses include a study of the historical development of numbers, computation, algebra, and geometry.
2073: Number theory algebra II level	Intended for students who have attained the objectives of algebra II, number theory algebra II–level courses review the properties and uses of integers and prime numbers and extend this information to congruences and divisibility.
Precalculus and above	
2053: Precalculus	Precalculus courses combine the study of trigonometry, elementary functions, analytic geometry, and math analysis topics as preparation for calculus. Topics include the study of complex numbers; polynomial, logarithmic, exponential, rational, right trigonometric, and circular functions and their relations, inverses, and graphs; trigonometric identities and equations; solutions of right and oblique triangles; vectors; the polar coordinate system; conic sections; Boolean algebra and symbolic logic; mathematical induction; matrix algebra; sequences and series; and limits and continuity. Review topics include the structure of the real number system and solving linear and quadratic equations and systems of these equations. Enhancement topics include elementary probability and statistics, derivatives, and integrals.
2054: Discrete math	Designed for students who have attained algebra II objectives, discrete mathematics topics include the study of polynomial, logarithmic, exponential, rational, right trigonometric, and circular functions and their relations and graphs; set theory; Boolean algebra and symbolic logic; combinatorics; recursion; basic algebraic structures; and graph theory.

(CONTINUED)

TABLE B1 (CONTINUED)

National Center for Education Statistics course codes, titles, and descriptions, by course content level

Codes by course content levels	Course description
2055: Calculus	Calculus courses are intended for students who have attained precalculus objectives, including some combination of trigonometry, elementary functions, analytic geometry, and math analysis, or precalculus. These courses include the study of derivatives, antiderivatives, differentiation, integration, the definite and indefinite integral, and applications of calculus. Review topics include properties of elementary functions and their graphs, vectors, and polar coordinates and concepts of limits and continuity. Enhancement topics include improper integral; multiple integration; sequences and series, including convergence tests and series expansion theorems; antidifferentiation; and differential equations.
2056: Multivariate calculus	Multivariate calculus courses include the study of hyperbolic functions, improper integrals, directional directives, and multiple integration and its applications. Enhancement topics include differential forms and vector calculus.
2058: AP calculus AB	AP (Advanced Placement) calculus AB provides students with an intuitive understanding of the concepts of calculus and experience with its methods and applications. These courses introduce calculus and include the following topics: elementary functions; properties of functions and their graphs; limits and continuity; differential calculus (including definition of the derivative, derivative formulas, theorems about derivatives, geometric applications, optimization problems, and rate-of-change problems); and integral calculus (including antiderivatives and the definite integral).
2059: AP calculus BC	AP calculus BC courses provide students with an intuitive understanding of the concepts of calculus and experience with its methods and applications. The courses also require additional knowledge of the theoretical tools of calculus. These courses assume a thorough knowledge of elementary functions and cover all of the calculus topics in AP calculus AB as well as the following topics: vector functions, parametric equations, and polar coordinates; rigorous definitions of finite and nonexistent limits; derivatives of vector functions and parametrically defined functions; advanced techniques of integration and advanced applications of the definite integral; and sequences and series.
2070: Computer math	Intended for students who have attained precalculus objectives, computer math precalculus-level courses include a study of computer systems and programming and use the computer to solve math problems.
2074: Abstract algebra precalculus level	Intended for students who have attained precalculus objectives, abstract algebra precalculus-level courses include a study of the properties of the number system from an abstract perspective, including such topics as number fields (that is, rational, real, and complex numbers), integral domains, rings, groups, polynomials, and the fundamental theorem of algebra.
2075: Linear algebra precalculus level	Intended for students who have attained precalculus objectives, linear algebra precalculus-level courses include a study of matrices, vectors, tensors, and linear transformations.
2076: Linear programming precalculus level	Intended for students who have attained precalculus objectives, linear programming precalculus-level courses include a study of mathematical modeling and the simplex method to solve linear inequalities.
Other	
2096: Mathematics independent study	Mathematics independent study courses, often conducted with instructors as mentors, enable students to explore mathematics topics of interest. These courses may be offered in conjunction with other rigorous math courses or may serve as an opportunity to explore a topic of special interest. They may also serve as an opportunity to study for AP exams if the school does not offer specific courses for that endeavor.
2099: Math other	

Source: Oregon Department of Education n.d.

APPENDIX C
SUPPLEMENTAL TABLES ON SCHOOL ENROLLMENT, ALL GRADES

TABLE C1
Overall school enrollment, 2006/07 and 2007/08

Statistic	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	Total
Enrollment	46,023	46,141	44,713	43,629	180,505	113,740	294,244
Valid number of schools	325	327	327	327	330	527	527

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the totals for each grade might not sum to the total across grades. Valid schools for each grade had enrollment data for that grade.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C2
School enrollment, by school variable, 2006/07 and 2007/08

School variable	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	All students
Size							
Small	1,737	1,970	2,257	2,726	8,689	4,210	12,899
Small/medium	4,769	4,899	4,855	5,159	19,680	16,568	36,248
Medium/large	4,518	4,690	4,653	4,721	18,582	55,717	74,299
Large	35,000	34,583	32,948	31,024	133,554	37,245	170,799
Locale							
Rural	7,846	7,859	7,711	7,438	30,854	20,084	50,938
Town	13,722	13,690	13,071	13,270	53,752	27,236	80,987
Suburb	9,805	9,863	9,423	8,875	37,966	29,310	67,276
City	14,651	14,729	14,509	14,046	57,934	37,110	95,044
Racial/ethnic minority population							
Low	8,183	8,279	8,006	7,700	32,167	14,066	46,233
Low/medium	10,942	10,973	10,745	10,598	43,257	26,589	69,846
Medium/high	14,020	14,199	13,770	13,117	55,105	34,745	89,850
High	12,878	12,691	12,193	12,215	49,976	38,340	88,316
Population eligible for free or reduced-price lunch							
Low	15,620	15,672	15,331	15,364	61,987	25,765	87,751
Low/medium	14,819	15,054	14,678	14,147	58,697	28,889	87,585
Medium/high	10,185	10,141	9,647	9,207	39,179	27,708	66,887
High	5,399	5,274	5,058	4,912	20,642	31,379	52,021

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C3

School enrollment in math, by course content level, 2006/07 and 2007/08

Course content level and statistic	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	All students
Below algebra I							
Enrollment	14,812	11,037	6,673	2,899	35,420	49,805	85,224
Number of schools	316	319	319	319	323	515	515
Algebra I							
Enrollment	15,109	6,781	3,004	929	25,823	8,189	34,012
Number of schools	320	320	320	319	324	515	515
Geometry							
Enrollment	7,443	11,240	5,727	1,923	26,332	1,783	28,115
Number of schools	318	320	319	319	323	515	515
Algebra II/trigonometry							
Enrollment	1,678	8,087	11,049	6,185	26,998	809	27,807
Number of schools	318	319	319	319	323	515	515
Precalculus and above							
Enrollment	151	1,106	5,200	5,524	11,980	229	12,208
Number of schools	317	319	319	319	321	515	515
All							
Enrollment	39,193	38,250	31,652	17,458	126,552	60,813	187,365
Number of schools	321	320	320	319	325	515	515

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C4

Student enrollment in math, by school size and course content level, 2006/07 and 2007/08

School size and course content level	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	All students
Small							
Below algebra I	771	638	528	433	2,369	2,187	4,556
Algebra I	483	284	136	64	966	402	1,368
Geometry	113	345	141	42	640	128	768
Algebra II/trigonometry	43	178	285	140	646	69	714
Precalculus and above	9	39	105	172	325	22	347
All	1,418	1,483	1,194	850	4,945	2,808	7,752
Small/medium							
Below algebra I	1,726	1,198	662	312	3,898	6,961	10,859
Algebra I	1,527	746	379	124	2,775	1,292	4,067
Geometry	593	1,177	669	194	2,632	203	2,835
Algebra II/trigonometry	121	764	1,261	519	2,665	87	2,752
Precalculus and above	21	53	332	474	879	44	922
All	3,987	3,938	3,302	1,622	12,848	8,587	21,434
Medium/large							
Below algebra I	1,487	962	579	267	3,294	24,373	27,667
Algebra I	1,507	858	395	118	2,878	3,573	6,451
Geometry	688	1,180	758	227	2,851	620	3,471
Algebra II/trigonometry	114	741	981	537	2,372	217	2,589
Precalculus and above	20	66	358	525	968	3	970
All	3,814	3,805	3,070	1,673	12,362	28,785	41,147
Large							
Below algebra I	10,829	8,239	4,904	1,887	25,859	16,284	42,143
Algebra I	11,593	4,894	2,095	623	19,205	2,922	22,127
Geometry	6,051	8,539	4,160	1,461	20,210	832	21,042
Algebra II/trigonometry	1,400	6,405	8,522	4,990	21,316	436	21,752
Precalculus and above	102	948	4,406	4,354	9,809	161	9,970
All	29,974	29,024	24,087	13,314	96,398	20,634	117,032

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C5

Student enrollment in math, by school locale and course content level, 2006/07 and 2007/08

School locale and course content level	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	Total
Rural							
Below algebra I	2,330	1,540	953	550	5,373	6,963	12,336
Algebra I	2,831	1,364	557	167	4,919	919	5,838
Geometry	1,068	2,046	1,087	323	4,523	435	4,958
Algebra II/trigonometry	248	1,340	1,782	795	4,164	155	4,319
Precalculus and above	25	150	911	1,002	2,088	47	2,134
All	6,501	6,440	5,289	2,836	21,065	8,519	29,584
Town							
Below algebra I	6,154	4,157	2,236	873	13,419	11,359	24,778
Algebra I	3,138	1,697	717	243	5,794	2,032	7,825
Geometry	1,412	2,651	1,694	506	6,262	651	6,913
Algebra II/trigonometry	436	1,810	2,578	1,311	6,135	484	6,618
Precalculus and above	45	177	991	1,200	2,412	146	2,558
All	11,184	10,490	8,215	4,133	34,021	14,670	48,691
Suburb							
Below algebra I	3,141	2,629	1,752	696	8,216	14,039	22,255
Algebra I	3,261	1,337	573	169	5,339	1,547	6,885
Geometry	1,926	2,316	1,021	348	5,610	300	5,910
Algebra II/trigonometry	530	2,017	2,559	1,613	6,718	85	6,803
Precalculus and above	30	314	1,412	1,577	3,332	3	3,334
All	8,886	8,611	7,316	4,401	29,214	15,972	45,186
City							
Below algebra I	3,189	2,712	1,732	780	8,412	17,445	25,857
Algebra I	5,880	2,384	1,158	350	9,772	3,692	13,464
Geometry	3,038	4,228	1,926	747	9,937	398	10,335
Algebra II/trigonometry	465	2,921	4,131	2,467	9,982	85	10,067
Precalculus and above	51	466	1,887	1,746	4,149	34	4,182
All	12,621	12,709	10,833	6,089	42,252	21,653	63,904

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C6

Student enrollment in math, by school racial/ethnic minority population and course content level, 2006/07 and 2007/08

School racial/ ethnic minority population and course content level	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	Total
Low							
Below algebra I	2,482	1,734	984	444	5,643	4,860	10,503
Algebra I	2,086	1,058	463	152	3,758	696	4,454
Geometry	1,239	1,757	906	238	4,140	236	4,376
Algebra II/trigonometry	408	1,597	1,692	720	4,416	98	4,514
Precalculus and above	36	230	1,021	954	2,241	38	2,278
All	6,249	6,376	5,065	2,508	20,198	5,927	26,124
Low/medium							
Below algebra I	3,912	2,520	1,298	498	8,227	12,563	20,790
Algebra I	3,524	1,726	643	192	6,085	1,892	7,976
Geometry	1,518	2,650	1,541	489	6,198	636	6,833
Algebra II/trigonometry	376	1,686	2,528	1,264	5,854	300	6,154
Precalculus and above	29	227	1,142	1,547	2,944	154	3,098
All	9,359	8,808	7,152	3,989	29,307	15,543	44,850
Medium/high							
Below algebra I	3,966	2,849	1,870	850	9,535	16,000	25,535
Algebra I	5,210	2,160	990	288	8,647	2,852	11,499
Geometry	2,866	3,993	1,870	698	9,426	384	9,810
Algebra II/trigonometry	558	2,991	3,972	2,340	9,860	58	9,918
Precalculus and above	61	388	1,820	1,730	3,998	13	4,011
All	12,661	12,380	10,521	5,905	41,465	19,306	60,771
High							
Below algebra I	4,453	3,934	2,522	1,107	12,015	16,382	28,397
Algebra I	4,290	1,837	910	297	7,333	2,751	10,084
Geometry	1,820	2,841	1,410	498	6,569	528	7,097
Algebra II/trigonometry	337	1,813	2,857	1,862	6,868	353	7,221
Precalculus and above	25	262	1,218	1,294	2,798	24	2,822
All	10,924	10,687	8,915	5,057	35,582	20,038	55,620

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE C7

Student enrollment in math, by school population eligible for free or reduced-price lunch and course content level, 2006/07 and 2007/08

School population eligible for free or reduced-price lunch and course content level	Grade 9	Grade 10	Grade 11	Grade 12	Grades 9–12	Other grades	Total
Low							
Below algebra I	3,499	2,658	1,757	943	8,856	10,179	19,035
Algebra I	5,639	1,960	833	281	8,712	2,401	11,113
Geometry	3,804	4,263	1,796	625	10,487	549	11,036
Algebra II/trigonometry	879	4,054	4,622	2,546	12,101	135	12,236
Precalculus and above	72	652	2,765	2,598	6,086	47	6,133
All	13,892	13,585	11,773	6,993	46,242	13,310	59,551
Low/medium							
Below algebra I	5,282	3,956	2,165	809	12,211	13,528	25,739
Algebra I	4,809	2,398	1,105	302	8,614	1,901	10,515
Geometry	1,798	3,383	2,010	657	7,848	544	8,392
Algebra II/trigonometry	493	1,999	3,227	1,995	7,713	280	7,993
Precalculus and above	25	281	1,325	1,503	3,134	140	3,274
All	12,406	12,017	9,831	5,265	39,518	16,393	55,911
Medium/high							
Below algebra I	3,871	2,641	1,716	689	8,917	12,056	20,972
Algebra I	3,305	1,648	663	218	5,834	1,725	7,559
Geometry	1,347	2,511	1,300	433	5,590	376	5,966
Algebra II/trigonometry	249	1,484	2,125	1,117	4,974	147	5,120
Precalculus and above	54	149	878	1,005	2,085	33	2,118
All	8,825	8,431	6,681	3,462	27,399	14,336	41,734
High							
Below algebra I	2,161	1,783	1,035	458	5,437	14,042	19,479
Algebra I	1,357	776	404	128	2,664	2,162	4,826
Geometry	495	1,084	621	208	2,408	314	2,722
Algebra II/trigonometry	58	551	1,075	528	2,211	248	2,459
Precalculus and above	0	25	233	418	675	10	685
All	4,071	4,217	3,367	1,740	13,394	16,775	30,169

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX D
TEACHER AND ENDORSEMENT COUNTS

FIGURE D1
Number of teachers teaching high school–level math, by school variable, 2006/07 and 2007/08

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE D1
Number of teachers, by type of endorsement, 2006/07 and 2007/08

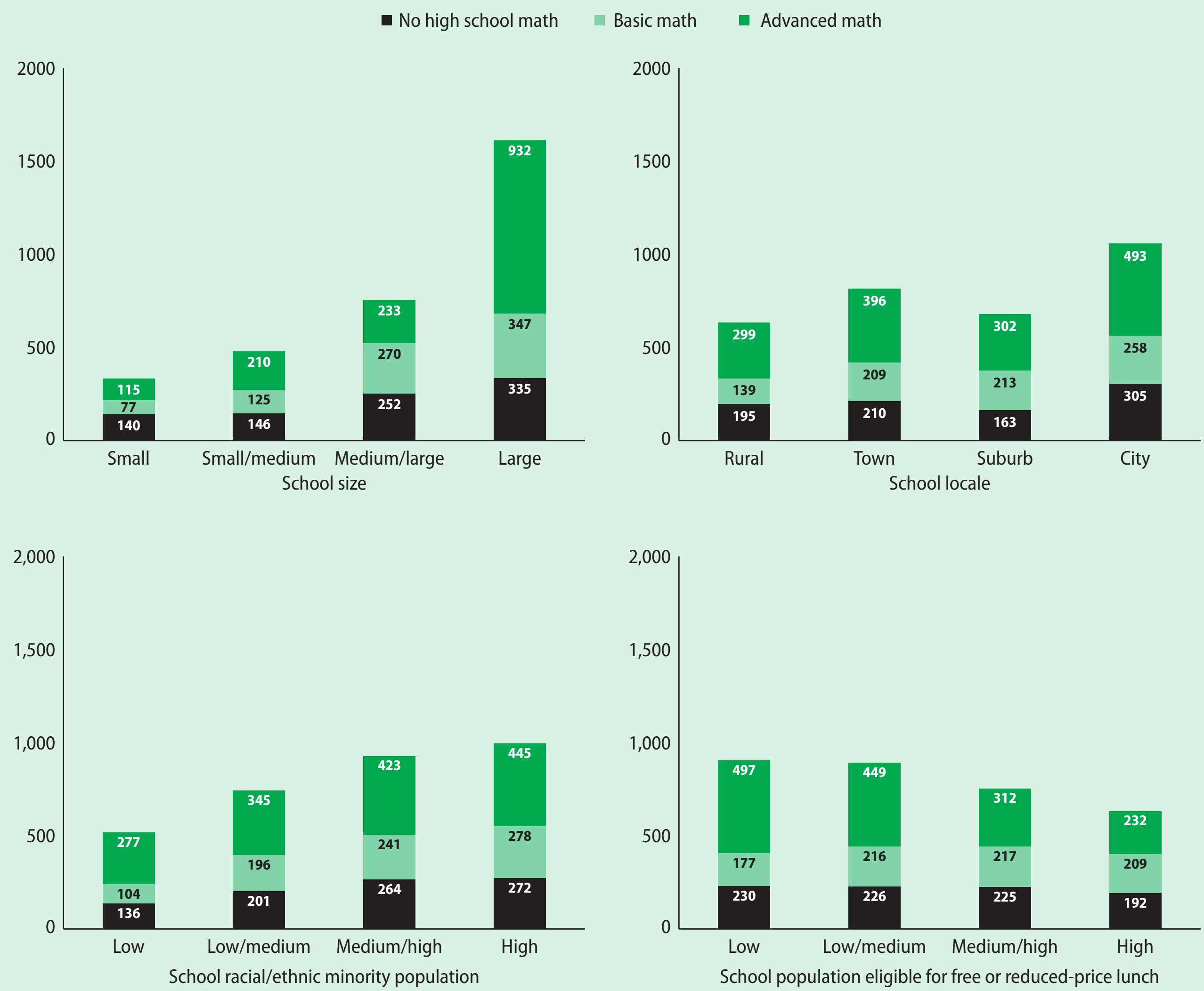
Statistic	No high school–level math	Basic math	Advanced math	Any
Number of teacher endorsements	873	819	1,490	3,182
Valid number of schools	510	510	510	510

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the totals for each endorsement type might not sum to the total across endorsement types. Valid schools had teacher-endorsement data.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE D2

Number of math teachers, by endorsement type and school variable, 2006/07 and 2007/08



Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE D2

Number of teachers, by endorsement type and school variable, 2006/07 and 2007/08

School variable and subcategory	No high school–level math	Basic math	Advanced math	Any endorsement
School size				
Small	140	77	115	332
Small/medium	146	125	210	481
Medium/large	252	270	233	755
Large	335	347	932	1,614
School locale				
Rural	195	139	299	633
Town	210	209	396	815
Suburb	163	213	302	678
City	305	258	493	1,056
School racial/ethnic minority population				
Low	136	104	277	517
Low/medium	201	196	345	742
Medium/high	264	241	423	928
High	272	278	445	995
School population eligible for free or reduced-price lunch				
Low	230	177	497	904
Low/medium	226	216	449	891
Medium/high	225	217	312	754
High	192	209	232	633

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each endorsement type might not sum to the total across endorsement types.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX E
NUMBER OF MATH CLASS SECTIONS TAUGHT

TABLE E1

Math class sections taught, by course content level, 2006/07 and 2007/08

Course content level and statistic	Sections taught	Sections taught by a properly endorsed teacher
Below algebra I		
Number of sections	3,920	3,191
Valid number of schools	496	480
Algebra I		
Number of sections	1,470	1,397
Valid number of schools	455	396
Geometry		
Number of sections	1,168	1,109
Valid number of schools	360	291
Algebra II/trigonometry		
Number of sections	1,186	1,149
Valid number of schools	323	286
Precalculus and above		
Number of sections	601	597
Valid number of schools	323	233
All high school–level math courses		
Number of sections	8,344	7,442
Valid number of schools	513	510

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results. Valid schools had data for the number of sections taught.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE E2

Math class sections taught, by course content level and school size, 2006/07 and 2007/08

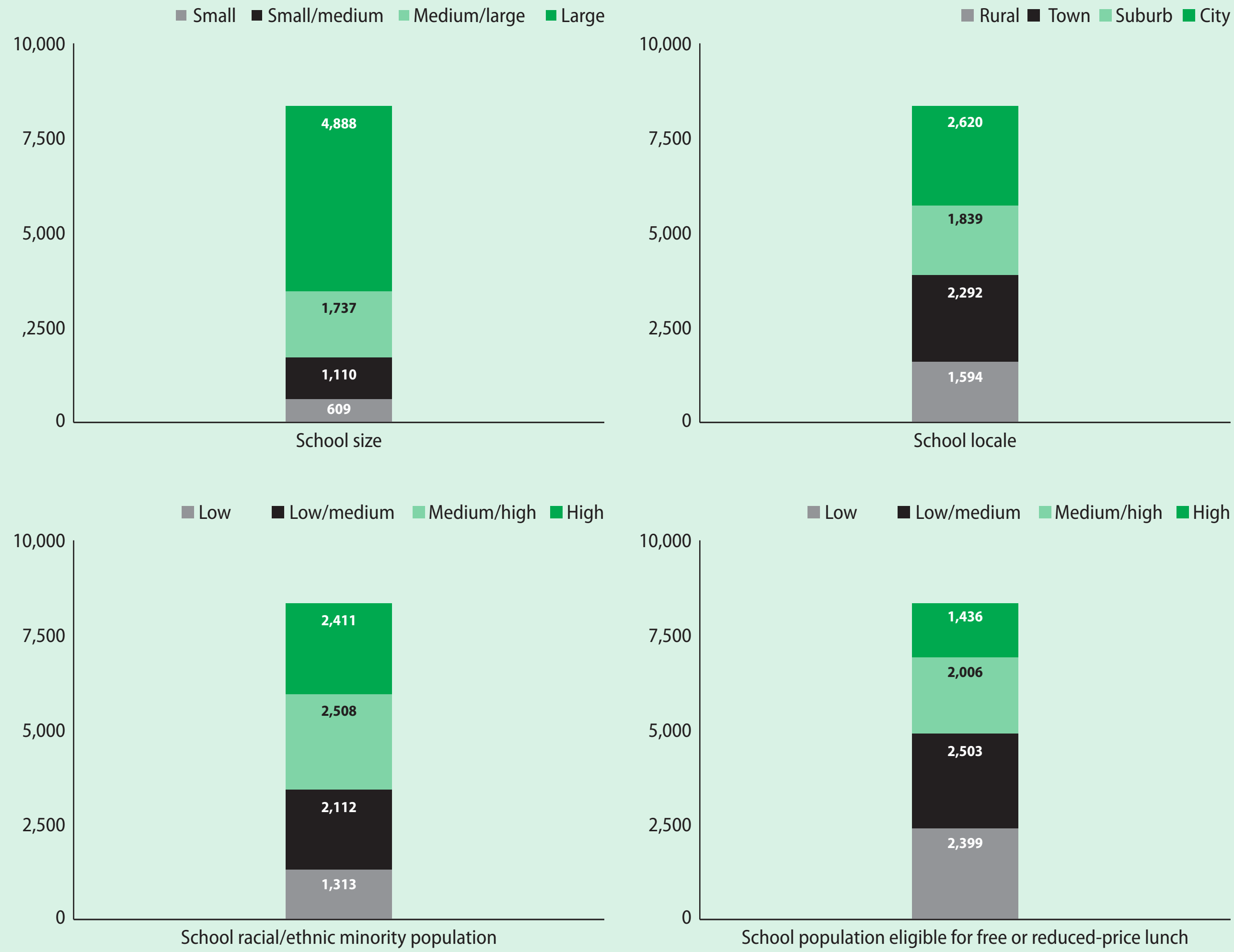
Course content level and school size	Sections taught	Sections taught by a properly endorsed teacher
Below algebra I		
Small	315	227
Small/medium	506	398
Medium/large	1,150	917
Large	1,950	1,651
Algebra I		
Small	98	81
Small/medium	201	186
Medium/large	266	243
Large	905	887
Geometry		
Small	71	55
Small/medium	156	143
Medium/large	150	135
Large	793	777
Algebra II/trigonometry		
Small	81	66
Small/medium	156	151
Medium/large	115	109
Large	835	824
Precalculus and above		
Small	45	43
Small/medium	93	93
Medium/large	57	57
Large	406	403
All high school–level math courses		
Small	609	471
Small/medium	1,110	970
Medium/large	1,737	1,460
Large	4,888	4,542

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

FIGURE E1

Math class sections taught, by school variable, 2006/07 and 2007/08



Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE E3

Math class sections taught, by course content level and school locale, 2006/07 and 2007/08

Course content level and school locale	Sections taught	Sections taught by a properly endorsed teacher
Below algebra I		
Rural	647	502
Town	1,149	980
Suburb	997	844
City	1,128	866
Algebra I		
Rural	299	282
Town	380	359
Suburb	257	248
City	534	509
Geometry		
Rural	242	228
Town	322	308
Suburb	210	203
City	395	371
Algebra II/trigonometry		
Rural	250	237
Town	299	289
Suburb	245	238
City	393	386
Precalculus and above		
Rural	157	157
Town	143	140
Suburb	131	130
City	171	170
All high school–level math courses		
Rural	1,595	1,404
Town	2,292	2,076
Suburb	1,839	1,662
City	2,620	2,301

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE E4

Math class sections taught, by course content level and school racial/ethnic minority population, 2006/07 and 2007/08

Course content level and school racial/ethnic minority population	Sections taught	Sections taught by a properly endorsed teacher
Below algebra I		
Low	540	440
Low/medium	1,029	857
Medium/high	1,099	885
High	1,252	1,010
Algebra I		
Low	220	207
Low/medium	351	330
Medium/high	461	436
High	439	425
Geometry		
Low	195	188
Low/medium	297	279
Medium/high	380	359
High	298	284
Algebra II/trigonometry		
Low	223	213
Low/medium	274	265
Medium/high	396	388
High	294	283
Precalculus and above		
Low	137	136
Low/medium	163	160
Medium/high	173	173
High	129	129
All high school–level math courses		
Low	1,313	1,183
Low/medium	2,112	1,890
Medium/high	2,508	2,240
High	2,411	2,130

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE E5

Math class sections taught, by course content level and school population eligible for free or reduced-price lunch

Course content level and school population eligible for free or reduced-price lunch	Sections taught	Sections taught by a properly endorsed teacher
Below algebra I		
Low	864	704
Low/medium	1,180	983
Medium/high	989	798
High	888	707
Algebra I		
Low	431	401
Low/medium	451	435
Medium/high	359	344
High	230	218
Geometry		
Low	406	387
Low/medium	344	335
Medium/high	276	256
High	143	132
Algebra II/trigonometry		
Low	454	444
Low/medium	361	351
Medium/high	249	239
High	122	115
Precalculus and above		
Low	245	245
Low/medium	168	166
Medium/high	134	134
High	54	53
All high school–level math courses		
Low	2,399	2,181
Low/medium	2,503	2,269
Medium/high	2,006	1,769
High	1,436	1,224

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each endorsement type might not sum to the total across endorsement types.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX F SUPPLEMENTAL TABLES ON SCHOOL ENROLLMENT, GRADES 9–12

TABLE F1

Student enrollment in math, by grade, course content level, and school size, 2006/07 and 2007/08

Course content level and school size	Grade 9		Grade 10		Grade 11		Grade 12	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Below algebra I								
Small	771	44	638	32	528	23	433	16
Small/medium	1,726	36	1,198	24	662	14	312	6
Medium/large	1,487	33	962	21	579	12	267	6
Large	10,829	31	8,239	24	4,904	15	1,887	6
Algebra I								
Small	483	28	284	14	136	6	64	2
Small/medium	1,527	32	746	15	379	8	124	2
Medium/large	1,507	33	858	18	395	8	118	2
Large	11,593	33	4,894	14	2,095	6	623	2
Geometry								
Small	113	6	345	18	141	6	42	2
Small/medium	593	12	1,177	24	669	14	194	4
Medium/large	688	15	1,180	25	758	16	227	5
Large	6,051	17	8,539	25	4,160	13	1,461	5
Algebra II/trigonometry								
Small	43	2	178	9	285	13	140	5
Small/medium	121	3	764	16	1,261	26	519	10
Medium/large	114	3	741	16	981	21	537	11
Large	1,400	4	6,405	19	8,522	26	4,990	16
Precalculus and above								
Small	9	1	39	2	105	5	172	6
Small/medium	21	0	53	1	332	7	474	9
Medium/large	20	0	66	1	358	8	525	11
Large	102	0	948	3	4,406	13	4,354	14
No math								
Small	319	18	487	25	1,064	47	1,876	69
Small/medium	782	16	961	20	1,553	32	3,537	69
Medium/large	704	16	885	19	1,583	34	3,048	65
Large	5,026	14	5,559	16	8,861	27	17,711	57
School								
Small	1,737	100	1,970	100	2,257	100	2,726	100
Small/medium	4,769	100	4,899	100	4,855	100	5,159	100
Medium/large	4,518	100	4,690	100	4,653	100	4,721	100
Large	35,000	100	34,583	100	32,948	100	31,024	100

Note: Totals are averaged across 2006/07 and 2007/08 and are rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE F2

Student enrollment in math, by grade, course content level, and school locale, 2006/07 and 2007/08

Course content level and school locale	Grade 9		Grade 10		Grade 11		Grade 12	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Below algebra I								
Rural	2,330	30	1,540	20	953	12	550	7
Town	6,154	45	4,157	30	2,236	17	873	7
Suburb	3,141	32	2,629	27	1,752	19	696	8
City	3,189	22	2,712	18	1,732	12	780	6
Algebra I								
Rural	2,831	36	1,364	17	557	7	167	2
Town	3,138	23	1,697	12	717	5	243	2
Suburb	3,261	33	1,337	14	573	6	169	2
City	5,880	40	2,384	16	1,158	8	350	2
Geometry								
Rural	1,068	14	2,046	26	1,087	14	323	4
Town	1,412	10	2,651	19	1,694	13	506	4
Suburb	1,926	20	2,316	23	1,021	11	348	4
City	3,038	21	4,228	29	1,926	13	747	5
Algebra II/trigonometry								
Rural	248	3	1,340	17	1,782	23	795	11
Town	436	3	1,810	13	2,578	20	1,311	10
Suburb	530	5	2,017	20	2,559	27	1,613	18
City	465	3	2,921	20	4,131	28	2,467	18
Precalculus and above								
Rural	25	0	150	2	911	12	1,002	13
Town	45	0	177	1	991	8	1,200	9
Suburb	30	0	314	3	1,412	15	1,577	18
City	51	0	466	3	1,887	13	1,746	12
No math								
Rural	1,345	17	1,420	18	2,423	31	4,603	62
Town	2,538	18	3,200	23	4,857	37	9,137	69
Suburb	918	9	1,252	13	2,108	22	4,474	50
City	2,030	14	2,020	14	3,676	25	7,957	57
School								
Rural	7,846	100	7,859	100	7,711	100	7,439	100
Town	13,722	100	13,690	100	13,071	100	13,270	100
Suburb	9,805	100	9,863	100	9,423	100	8,875	100
City	14,651	100	14,729	100	14,509	100	14,046	100

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE F3

Student enrollment in math, by grade, course content level, and school racial/ethnic minority population, 2006/07 and 2007/08

Course content level and school racial/ethnic minority population	Grade 9		Grade 10		Grade 11		Grade 12	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Below algebra I								
Low	2,482	30	1,734	21	984	12	444	6
Low/medium	3,912	36	2,520	23	1,298	12	498	5
Medium/high	3,966	28	2,849	20	1,870	14	850	6
High	4,453	35	3,934	31	2,522	21	1,107	9
Algebra I								
Low	2,086	25	1,058	13	463	6	152	2
Low/medium	3,524	32	1,726	16	643	6	192	2
Medium/high	5,210	37	2,160	15	990	7	288	2
High	4,290	33	1,837	14	910	7	297	2
Geometry								
Low	1,239	15	1,757	21	906	11	238	3
Low/medium	1,518	14	2,650	24	1,541	14	489	5
Medium/high	2,866	20	3,993	28	1,870	14	698	5
High	1,820	14	2,841	22	1,410	12	498	4
Algebra II/trigonometry								
Low	408	5	1,597	19	1,692	21	720	9
Low/medium	376	3	1,686	15	2,528	24	1,264	12
Medium/high	558	4	2,991	21	3,972	29	2,340	18
High	337	3	1,813	14	2,857	23	1,862	15
Precalculus and above								
Low	36	0	230	3	1,021	13	954	12
Low/medium	29	0	227	2	1,142	11	1,547	15
Medium/high	61	0	388	3	1,820	13	1,730	13
High	25	0	262	2	1,218	10	1,294	11
No math								
Low	1,934	24	1,903	23	2,941	37	5,193	67
Low/medium	1,583	14	2,165	20	3,594	33	6,609	62
Medium/high	1,360	10	1,819	13	3,249	24	7,213	55
High	1,954	15	2,005	16	3,278	27	7,158	59
School								
Low	8,183	100	8,279	100	8,006	100	7,700	100
Low/medium	10,942	100	10,973	100	10,745	100	10,598	100
Medium/high	14,020	100	14,199	100	13,770	100	13,117	100
High	12,878	100	12,691	100	12,193	100	12,215	100

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE F4

Student enrollment in math, by grade, content level, and school population eligible for free or reduced-price lunch, 2006/07 and 2007/08

Course content level and school population eligible for free or reduced-price lunch	Grade 9		Grade 10		Grade 11		Grade 12	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Below algebra I								
Low	3,499	22	2,658	17	1,757	11	943	6
Low/medium	5,282	36	3,956	26	2,165	15	809	6
Medium/high	3,871	38	2,641	26	1,716	18	689	7
High	2,161	40	1,783	34	1,035	20	458	9
Algebra I								
Low	5,639	36	1,960	13	833	5	281	2
Low/medium	4,809	32	2,398	16	1,105	8	302	2
Medium/high	3,305	32	1,648	16	663	7	218	2
High	1,357	25	776	15	404	8	128	3
Geometry								
Low	3,804	24	4,263	27	1,796	12	625	4
Low/medium	1,798	12	3,383	22	2,010	14	657	5
Medium/high	1,347	13	2,511	25	1,300	13	433	5
High	495	9	1,084	21	621	12	208	4
Algebra II/trigonometry								
Low	879	6	4,054	26	4,622	30	2,546	17
Low/medium	493	3	1,999	13	3,227	22	1,995	14
Medium/high	249	2	1,484	15	2,125	22	1,117	12
High	58	1	551	10	1,075	21	528	11
Precalculus and above								
Low	72	0	652	4	2,765	18	2,598	17
Low/medium	25	0	281	2	1,325	9	1,503	11
Medium/high	54	1	149	1	878	9	1,005	11
High	0	0	25	0	233	5	418	8
No math								
Low	1,729	11	2,087	13	3,559	23	8,372	54
Low/medium	2,414	16	3,037	20	4,847	33	8,883	63
Medium/high	1,360	13	1,710	17	2,966	31	5,746	62
High	1,329	25	1,057	20	1,691	33	3,173	65
School								
Low	15,620	100	15,672	100	15,331	100	15,364	100
Low/medium	14,819	100	15,054	100	14,678	100	14,147	100
Medium/high	10,185	100	10,141	100	9,647	100	9,207	100
High	5,399	100	5,274	100	5,058	100	4,912	100

Note: Totals are averaged across 2006/07 and 2007/08 and rounded to whole numbers; therefore, the disaggregated results might not sum to the aggregated results, and the totals for each grade might not sum to the total across grades.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX G
SUPPLEMENTAL TABLES ON STUDENT ACCESS TO ADVANCED MATH–ENDORSED TEACHERS, RELATIVE TO NEED

TABLE G1

Estimated access to advanced math–endorsed teachers relative to need for small schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	8,689	640	646	325	1,533	1,527	0	4,669	115	1.4	8.2	1,347	29
2	8,689	640	646	325	1,533	0	0	3,142	115	1.4	8.2	1,347	43
3	8,348	640	646	325	1,448	0	0	3,057	115	1.4	8.2	1,347	44
4	7,646	640	646	325	1,272	0	0	2,882	115	1.4	8.2	1,347	47

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G2

Estimated access to advanced math–endorsed relative to need for small/medium schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	19,680	2,632	2,665	879	2,289	2,255	0	10,719	210	1.8	15.3	5,900	55
2	19,680	2,632	2,665	879	2,289	0	0	8,464	210	1.8	15.3	5,900	70
3	18,909	2,632	2,665	879	2,096	0	0	8,271	210	1.8	15.3	5,900	71
4	17,318	2,632	2,665	879	1,698	0	0	7,873	210	1.8	15.3	5,900	75

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G3

Estimated access to advanced math–endorsed teachers relative to need for medium/large schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	18,582	2,851	2,372	968	1,794	2,274	0	10,258	233	1.3	19.2	5,767	56
2	18,582	2,851	2,372	968	1,794	0	0	7,984	233	1.3	19.2	5,767	72
3	17,853	2,851	2,372	968	1,612	0	0	7,802	233	1.3	19.2	5,767	74
4	16,352	2,851	2,372	968	1,237	0	0	7,427	233	1.3	19.2	5,767	78

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G4

Estimated access to advanced math–endorsed teachers relative to need for large schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	133,554	20,210	21,316	9,809	13,179	12,073	0	76,586	932	2.2	25.2	50,578	66
2	133,554	20,210	21,316	9,809	13,179	0	0	64,514	932	2.2	25.2	50,578	78
3	128,319	20,210	21,316	9,809	11,870	0	0	63,205	932	2.2	25.2	50,578	80
4	117,528	20,210	21,316	9,809	9,172	0	0	60,507	932	2.2	25.2	50,578	84

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G5

Estimated access to advanced math–endorsed teachers relative to need for rural schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	30,854	4,523	4,164	2,088	3,191	3,550	0	17,515	299	2.1	16.6	10,310	59
2	30,854	4,523	4,164	2,088	3,191	0	0	13,966	299	2.1	16.6	10,310	74
3	29,645	4,523	4,164	2,088	2,888	0	0	13,663	299	2.1	16.6	10,310	75
4	27,152	4,523	4,164	2,088	2,265	0	0	13,040	299	2.1	16.6	10,310	79

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G6

Estimated access to advanced math–endorsed teachers relative to need for schools in towns

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	53,752	6,262	6,135	2,412	7,176	7,303	0	29,288	396	1.9	19.4	14,304	49
2	53,752	6,262	6,135	2,412	7,176	0	0	21,985	396	1.9	19.4	14,304	65
3	51,645	6,262	6,135	2,412	6,649	0	0	21,458	396	1.9	19.4	14,304	67
4	47,302	6,262	6,135	2,412	5,563	0	0	20,372	396	1.9	19.4	14,304	70

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G7

Estimated access to advanced math–endorsed teachers relative to need for schools in suburbs

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	37,966	5,610	6,718	3,332	3,882	2,774	0	22,315	302	1.9	26.7	15,232	68
2	37,966	5,610	6,718	3,332	3,882	0	0	19,542	302	1.9	26.7	15,232	78
3	36,478	5,610	6,718	3,332	3,509	0	0	19,169	302	1.9	26.7	15,232	79
4	33,410	5,610	6,718	3,332	2,743	0	0	18,403	302	1.9	26.7	15,232	83

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G8

Estimated access to advanced math–endorsed teachers relative to need for schools in cities

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	57,934	9,937	9,982	4,149	4,547	4,502	0	33,116	493	1.9	25.1	23,289	70
2	57,934	9,937	9,982	4,149	4,547	0	0	28,615	493	1.9	25.1	23,289	81
3	55,663	9,937	9,982	4,149	3,979	0	0	28,047	493	1.9	25.1	23,289	83
4	50,982	9,937	9,982	4,149	2,808	0	0	26,876	493	1.9	25.1	23,289	87

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G9

Estimated access to advanced math–endorsed teachers relative to need for low–racial/ethnic minority schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	32,167	4,140	4,416	2,241	3,902	3,626	0	18,324	277	1.9	19.5	10,465	57
2	32,167	4,140	4,416	2,241	3,902	0	0	14,698	277	1.9	19.5	10,465	71
3	30,906	4,140	4,416	2,241	3,587	0	0	14,383	277	1.9	19.5	10,465	73
4	28,307	4,140	4,416	2,241	2,937	0	0	13,733	277	1.9	19.5	10,465	76

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G10

Estimated access to advanced math–endorsed teachers relative to need for low/medium–racial/ethnic minority schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	43,257	6,198	5,854	2,944	4,617	4,960	0	24,573	345	2.0	20.5	14,402	59
2	43,257	6,198	5,854	2,944	4,617	0	0	19,612	345	2.0	20.5	14,402	73
3	41,561	6,198	5,854	2,944	4,193	0	0	19,188	345	2.0	20.5	14,402	75
4	38,066	6,198	5,854	2,944	3,319	0	0	18,315	345	2.0	20.5	14,402	79

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G11

Estimated access to advanced math–endorsed teachers relative to need for medium/high–racial/ethnic minority schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	55,105	9,426	9,860	3,998	4,350	3,916	0	31,550	423	2.2	24.5	22,547	71
2	55,105	9,426	9,860	3,998	4,350	0	0	27,634	423	2.2	24.5	22,547	82
3	52,945	9,426	9,860	3,998	3,810	0	0	27,094	423	2.2	24.5	22,547	83
4	48,492	9,426	9,860	3,998	2,697	0	0	25,981	423	2.2	24.5	22,547	87

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G12

Estimated access to advanced math–endorsed teachers relative to need for high–racial/ethnic minority schools

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	49,976	6,569	6,868	2,798	5,926	5,626	0	27,786	445	1.6	22.5	15,671	56
2	49,976	6,569	6,868	2,798	5,926	0	0	22,160	445	1.6	22.5	15,671	71
3	48,017	6,569	6,868	2,798	5,436	0	0	21,670	445	1.6	22.5	15,671	72
4	43,979	6,569	6,868	2,798	4,426	0	0	20,660	445	1.6	22.5	15,671	76

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G13

Estimated access to advanced math–endorsed teachers relative to need for schools with a low population eligible for free or reduced-price lunch

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	61,987	10,487	12,101	6,086	5,010	3,396	0	37,079	497	2.2	25.9	27,921	75
2	61,987	10,487	12,101	6,086	5,010	0	0	33,684	497	2.2	25.9	27,921	83
3	59,557	10,487	12,101	6,086	4,402	0	0	33,076	497	2.2	25.9	27,921	84
4	54,548	10,487	12,101	6,086	3,150	0	0	31,824	497	2.2	25.9	27,921	88

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G14

Estimated access to advanced math–endorsed teachers relative to need for schools with a low/medium population eligible for free or reduced-price lunch

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	58,697	7,848	7,713	3,134	6,827	6,962	0	32,482	449	1.9	21.4	18,244	56
2	58,697	7,848	7,713	3,134	6,827	0	0	25,520	449	1.9	21.4	18,244	71
3	56,396	7,848	7,713	3,134	6,252	0	0	24,945	449	1.9	21.4	18,244	73
4	51,653	7,848	7,713	3,134	5,066	0	0	23,759	449	1.9	21.4	18,244	77

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G15

Estimated access to advanced math–endorsed teachers relative to need for schools with a medium/high population eligible for free or reduced-price lunch

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	39,179	5,590	4,974	2,085	4,205	4,821	0	21,675	312	2.0	19.2	12,053	56
2	39,179	5,590	4,974	2,085	4,205	0	0	16,853	312	2.0	19.2	12,053	72
3	37,643	5,590	4,974	2,085	3,821	0	0	16,469	312	2.0	19.2	12,053	73
4	34,478	5,590	4,974	2,085	3,030	0	0	15,678	312	2.0	19.2	12,053	77

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE G16

Estimated access to advanced math–endorsed teachers relative to need for schools with a high population eligible for free or reduced-price lunch

		Current demand			Additional demand				Access to advanced math–endorsed teachers				
Model[a]	School enrollment	Geometry	Algebra II	Calculus	Geometry	Algebra II	Calculus	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section	Students with access to an advanced math–endorsed teacher	Access as percentage of need
1	20,642	2,408	2,211	675	2,753	2,950	0	10,996	232	1.3	16.9	5,057	46
2	20,642	2,408	2,211	675	2,753	0	0	8,047	232	1.3	16.9	5,057	63
3	19,833	2,408	2,211	675	2,550	0	0	7,844	232	1.3	16.9	5,057	64
4	18,165	2,408	2,211	675	2,133	0	0	7,427	232	1.3	16.9	5,057	68

a. Model 1 estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 2 estimates include the entire grade 9–12 student population and assume that students take only one advanced math course (geometry) to meet requirements, that the 2006/07 and 2007/08 demand for advanced math courses remains the same, and that the grade 9–12 student–teacher ratio is the average across all schools in the study. Model 3 is the same as model 2 but with the grade 9–12 student population reduced by 3.92 percent (the average dropout rate). Model 4 is the same as model 2 but with the grade 9–12 student population reduced by 12 percent (the percentage of students who receive an alternative diploma).

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX H
SUPPLEMENTAL TABLES FOR ADDITIONAL MODEL ESTIMATES

Changes would be needed to ensure that 100 percent of students needing to take advanced math classes would have access to an advanced math–endorsed teacher (see findings in main report). As a follow-up, additional model estimates were conducted using models 1 and 4 from the main report to determine what would be needed to meet the estimated demand, holding the 2006/07 and 2007/08 advanced math–endorsed teacher availability constant. More specifically, the estimates were run to determine how many more advanced math–endorsed teachers would be needed, how many more class sections would the currently available advanced math–endorsed teachers (averaged across 2006/07 and 2007/08) have to teach, and how many more students per class section would be needed to reach 100 percent access for all grade 9–12 students, compared with 2006/07 and 2007/08 levels. These follow-up model estimates, conducted for all schools and then for each school variable, were used for models 1 and 4, which represented the range of the percentage of students that would require access to an advanced math–endorsed teacher.

Statewide results

An increase of 25–63 percent would be needed in one of three areas: the number of teachers with advanced math endorsements, the number of class sections taught by advanced math–endorsed teachers, or the number of students in each class section (table H1). The total increase could also be attained by increases across all three areas. The subcategories most in need of these changes were small schools, rural schools, schools in towns, and schools with a high population eligible for free or reduced-price lunch. Differences among schools with varying racial/ethnic minority populations were minimal.

Advanced math–endorsed teachers taught an average of 1.9 sections of advanced math courses. Many of these teachers are full-time equivalent and thus teaching up to five class sections a day, suggesting that they are teaching three other class sections of either lower level math or nonmath courses. It is possible for these teachers to reduce their lower level math or nonmath course load so that they can teach more advanced math courses. As shown in the model estimates, increasing the average number of advanced math class sections taught by an advanced math–endorsed teacher to 2.4 (for model 1) or 3.1 (for model 4) eliminates the shortage for most school subcategories. Doing so requires that advanced math–endorsed teachers increase their course load of advanced math class sections by an average of up to 1.2. To enable the advanced math–endorsed teachers to teach these additional sections, other teachers would need to cover about 1,800 class sections (1,490 advanced math–endorsed teachers multiplied by 1.2). If teachers with the basic math endorsement—or with no math endorsement—increase their basic-math or nonmath course load by 1.1 sections, that gap would be filled. However, the data do not provide information on whether these teachers can increase their course load by 1.2 class sections. Nonetheless, if the new graduation requirements cause students to take more advanced math courses, these students might take fewer lower level math or nonmath courses, thereby allowing the courses that teachers with advanced, basic, and no math endorsement are teaching to be redistributed.

Results by school size

An increase in any of the following areas would allow schools to meet the grade 9–12 student demand for advanced math courses in schools of each size: the number of advanced math–endorsed teachers, the number of class sections taught by advanced math–endorsed teachers, or the number of students in each class section (tables H2–H5). For small schools, the size of the increase across these conditions would need to be 114–247 percent. For small/medium schools, 33–82 percent. For medium/large schools, 29–78 percent. For large schools, 20–51 percent (table H6).

TABLE H1

Increase needed to reach 100 percent access to advanced math–endorsed teachers

	Model 1				Model 4			
Variable	From	To	Difference	Percentage increase	From	To	Difference	Percentage increase
Advanced math–endorsed teachers	1,490	2,413	923	62	1,490	1,859	369	25
Class sections taught by teachers	1.9	3.1	1.2	63	1.9	2.4	0.47	25
Students in class section	22.1	36.1	14.0	63	22.1	27.6	5.46	25

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H2

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for small schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	8,689	4,669	399	1.4	8.2
A-4	7,646	2,882	246	1.4	8.2
B-1	8,689	4,669	115	4.9	8.2
B-4	7,646	2,882	115	3.1	8.2
C-1	8,689	4,669	115	1.4	28.5
C-4	7,646	2,882	115	1.4	17.6

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H3

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for small/medium schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	19,680	10,719	382	1.8	15.3
A-4	17,318	7,873	280	1.8	15.3
B-1	19,680	10,719	210	3.3	15.3
B-4	17,318	7,873	210	2.5	15.3
C-1	19,680	10,719	210	1.8	27.8
C-4	17,318	7,873	210	1.8	20.4

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using author-created dataset from multiple sources.

TABLE H4

Increase in advanced math–endorsed teachers, class sections taught, or grade 9-12 students per class section needed to reach 100 percent access for medium/large schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	18,582	10,258	414	1.3	19.2
A-4	16,352	7,427	300	1.3	19.2
B-1	18,582	10,258	233	2.3	19.2
B-4	16,352	7,427	233	1.7	19.2
C-1	18,582	10,258	233	1.3	34.2
C-4	16,352	7,427	233	1.3	24.8

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H5

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for large schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	133,554	76,586	1,411	2.2	25.2
A-4	117,528	60,507	1,115	2.2	25.2
B-1	133,554	76,586	932	3.3	25.2
B-4	117,528	60,507	932	2.6	25.2
C-1	133,554	76,586	932	2.2	38.2
C-4	117,528	60,507	932	2.2	30.2

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H6

Increase needed to reach 100 percent access to advanced math–endorsed teachers, by school size

	Model 1				Model 4			
Variable and school size	From	To	Difference	Percentage increase	From	To	Difference	Percentage increase
A. Advanced math–endorsed teachers								
Small	115.0	398.7	283.7	247	115.0	246.1	131.1	114
Small/medium	210.0	381.5	171.5	82	210.0	280.2	70.2	33
Medium/large	233.0	414.5	181.5	78	233.0	300.1	67.1	29
Large	932.0	1,411.3	479.3	51	932.0	1115.0	183.0	20
B. Class sections taught by teachers								
Small	1.4	4.9	3.5	247	1.4	3.1	1.6	114
Small/medium	1.8	3.3	1.5	82	1.8	2.5	0.6	33
Medium/large	1.3	2.3	1.0	78	1.3	1.7	0.4	29
Large	2.2	3.3	1.1	51	2.2	2.6	0.4	20
C. Students per class section								
Small	8.2	28.5	20.3	247	8.2	17.6	9.4	114
Small/medium	15.3	27.8	12.5	82	15.3	20.4	5.1	33
Medium/large	19.2	34.2	15.0	78	19.2	24.8	5.5	29
Large	25.2	38.2	13.0	51	25.2	30.2	5.0	20

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

Results by school locale

An increase in any of the following areas would allow schools to meet the grade 9–12 student demand for advanced math courses: the number of advanced math–endorsed teachers, the number of class sections taught by advanced math–endorsed teachers, or the number of students in each class section (tables H7–H10). For rural schools, the size of the increase across these conditions would need to be 26–70 percent (table H11). For schools in towns, 42–105 percent. For schools in suburbs, 21–46 percent. For schools in cities, 15–42 percent.

TABLE H7

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for rural schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	30,854	17,515	508	2.1	16.6
A-4	27,152	13,040	378	2.1	16.6
B-1	30,854	17,515	299	3.5	16.6
B-4	27,152	13,040	299	2.6	16.6
C-1	30,854	17,515	299	2.1	28.2
C-4	27,152	13,040	299	2.1	21.0

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H8

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools in towns

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	53,752	29,288	811	1.9	19.4
A-4	47,302	20,372	564	1.9	19.4
B-1	53,752	29,288	396	3.8	19.4
B-4	47,302	20,372	396	2.7	19.4
C-1	53,752	29,288	396	1.9	39.7
C-4	47,302	20,372	396	1.9	27.6

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H9

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools in suburbs

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	37,966	22,315	442	1.9	26.7
A-4	33,410	18,403	365	1.9	26.7
B-1	37,966	22,315	302	2.8	26.7
B-4	33,410	18,403	302	2.3	26.7
C-1	37,966	22,315	302	1.9	39.2
C-4	33,410	18,403	302	1.9	32.3

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H10

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools in cities

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	57,934	33,116	701	1.9	25.1
A-4	50,982	26,876	569	1.9	25.1
B-1	57,934	33,116	493	2.7	25.1
B-4	50,982	26,876	493	2.2	25.1
C-1	57,934	33,116	493	1.9	35.7
C-4	50,982	26,876	493	1.9	29.0

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced-level math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H11

Increase needed to reach 100 percent access to advanced math–endorsed teachers, by school locale

	Model 1				Model 4			
Variable and school locale	From	To	Difference	Percentage increase	From	To	Difference	Percentage increase
A. Advanced math–endorsed teachers								
Rural	299.0	507.9	208.9	70	299.0	378.2	79.2	26
Town	396.0	810.8	414.8	105	396.0	564.0	168.0	42
Suburb	302.0	442.4	140.4	46	302.0	364.9	62.9	21
City	493.0	701.0	208.0	42	493.0	568.9	75.9	15
B. Class sections taught by teachers								
Rural	2.1	3.5	1.5	70	2.1	2.6	0.5	26
Town	1.9	3.8	1.9	105	1.9	2.7	0.8	42
Suburb	1.9	2.8	0.9	46	1.9	2.3	0.4	21
City	1.9	2.7	0.8	42	1.9	2.2	0.3	15
C. Students per class section								
Rural	16.6	28.2	11.6	70	16.6	21.0	4.4	26
Town	19.4	39.7	20.3	105	19.4	27.6	8.2	42
Suburb	26.7	39.2	12.4	47	26.7	32.3	5.6	21
City	25.1	35.7	10.6	42	25.1	29.0	3.9	15

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

Results by school racial/ethnic minority population

An increase in any of the following areas would allow schools to meet the grade 9–12 student demand for advanced math courses: the number of advanced math–endorsed teachers, the number of class sections taught by advanced math–endorsed teachers, or the number of students in each class section (tables H12–H15). For schools with a low racial/ethnic minority population, the size of the increase across these conditions would need to be 31–75 percent (table H16). For schools with a low/medium racial/ethnic minority population, 27–71 percent. For schools with a medium/high racial/ethnic minority population, 15–40 percent. For schools with a high racial/ethnic minority population, 32–77 percent.

TABLE H12

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for low–racial/ethnic minority schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	32,167	18,324	485	1.9	19.5
A-4	28,307	13,733	364	1.9	19.5
B-1	32,167	18,324	277	3.4	19.5
B-4	28,307	13,733	277	2.5	19.5
C-1	32,167	18,324	277	1.9	34.1
C-4	28,307	13,733	277	1.9	25.6

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H13

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for low/medium–racial/ethnic minority schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	43,257	24,573	589	2.0	20.5
A-4	38,066	18,315	439	2.0	20.5
B-1	43,257	24,573	345	3.5	20.5
B-4	38,066	18,315	345	2.6	20.5
C-1	43,257	24,573	345	2.0	34.9
C-4	38,066	18,315	345	2.0	26.0

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H14

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for medium/high–racial/ethnic minority schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	55,105	31,550	592	2.2	24.5
A-4	48,492	25,981	487	2.2	24.5
B-1	55,105	31,550	423	3.0	24.5
B-4	48,492	25,981	423	2.5	24.5
C-1	55,105	31,550	423	2.2	34.3
C-4	48,492	25,981	423	2.2	28.3

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H15

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for high–racial/ethnic minority schools

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	49,976	27,786	789	1.6	22.5
A-4	43,979	20,660	587	1.6	22.5
B-1	49,976	27,786	445	2.8	22.5
B-4	43,979	20,660	445	2.1	22.5
C-1	49,976	27,786	445	1.6	39.9
C-4	43,979	20,660	445	1.6	29.7

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H16

Increase needed to reach 100 percent access to advanced math–endorsed teachers, by school racial/ethnic minority population

Variable and school racial/ethnic minority population	Model 1				Model 4			
	From	To	Difference	Percentage increase	From	To	Difference	Percentage increase
A. Advanced math–endorsed teachers								
Low	277.0	485.0	208.0	75	277.0	363.5	86.5	31
Low/medium	345.0	588.6	243.6	71	345.0	438.7	93.7	27
Medium/high	423.0	591.9	168.9	40	423.0	487.4	64.4	15
High	445.0	789.0	344.0	77	445.0	586.7	141.7	32
B. Class sections taught by teachers								
Low	1.9	3.4	1.5	75	1.9	2.5	0.6	31
Low/medium	2.0	3.5	1.4	71	2.0	2.6	0.6	27
Medium/high	2.2	3.0	0.9	40	2.2	2.5	0.3	15
High	1.6	2.8	1.2	77	1.6	2.1	0.5	32
C. Students per class section								
Low	19.5	34.1	14.6	75	19.5	25.6	6.1	31
Low/medium	20.5	34.9	14.4	71	20.5	26.0	5.6	27
Medium/high	24.5	34.3	9.8	40	24.5	28.3	3.7	15
High	22.5	39.9	17.4	77	22.5	29.7	7.2	32

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

Results by school population eligible for free or reduced-price lunch

An increase in any of the following areas would allow schools to meet the grade 9–12 student demand for advanced-level math courses: the number of advanced math–endorsed teachers, the number of class sections taught by advanced math–endorsed teachers, or the number of students in each class section (tables H17–H20). For schools with a low population eligible for free or reduced-price lunch, the size of the increase across these conditions would need to be 14–33 percent (table H21). For schools with a low/medium population eligible for free or reduced-price lunch, 30–78 percent. For schools with a medium/high population eligible for free or reduced-price lunch, 30–80 percent. For schools with a high population eligible for free or reduced-price lunch, 47–117 percent.

TABLE H17

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools with a low population eligible for free or reduced-price lunch

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	61,987	37,079	660	2.2	25.9
A-4	54,548	31,824	566	2.2	25.9
B-1	61,987	37,079	497	2.9	25.9
B-4	54,548	31,824	497	2.5	25.9
C-1	61,987	37,079	497	2.2	34.5
C-4	54,548	31,824	497	2.2	29.6

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H18

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools with a low/medium population eligible for free or reduced-price lunch

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	58,697	32,482	799	1.9	21.4
A-4	51,653	23,759	585	1.9	21.4
B-1	58,697	32,482	449	3.4	21.4
B-4	51,653	23,759	449	2.5	21.4
C-1	58,697	32,482	449	1.9	38.1
C-4	51,653	23,759	449	1.9	27.9

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H19

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools with a medium/high population eligible for free or reduced-price lunch

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	39,179	21,675	561	2.0	19.2
A-4	34,478	15,678	406	2.0	19.2
B-1	39,179	21,675	312	3.6	19.2
B-4	34,478	15,678	312	2.6	19.2
C-1	39,179	21,675	312	2.0	34.5
C-4	34,478	15,678	312	2.0	25.0

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H20

Increase in advanced math–endorsed teachers, class sections taught, or grade 9–12 students per class section needed to reach 100 percent access for schools with a high population eligible for free or reduced-price lunch

Model	Enrollment	New demand for advanced math courses	Advanced math–endorsed teachers	Class sections taught per advanced math–endorsed teacher	Students per advanced math class section
A-1	20,642	10,996	504	1.3	16.9
A-4	18,165	7,427	341	1.3	16.9
B-1	20,642	10,996	232	2.8	16.9
B-4	18,165	7,427	232	1.9	16.9
C-1	20,642	10,996	232	1.3	36.5
C-4	18,165	7,427	232	1.3	25.0

Note: Models A-1 and A-4 estimate the increase in the number of advanced math–endorsed teachers needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. B-1 and B-4 estimate the increase in advanced math class sections taught needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. C-1 and C-4 estimate the increase in the number of grade 9–12 students in each advanced math class section needed to reach 100 percent grade 9–12 access to advanced math–endorsed teachers. For A-1, B-1, and C-1, estimates include the entire grade 9–12 student population and assume that students take two advanced math courses (geometry and algebra II) to meet requirements. For A-4, B-4, and C-4, the student population is reduced by 12 percent (the percentage of students who receive an alternative diploma), and it is assumed that students take one advanced math course (geometry) to meet the requirements.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

TABLE H21

Increase needed to reach 100 percent access to advanced math–endorsed teacher, by school population eligible for free or reduced-price lunch

Variable and school population eligible for free or reduced-price lunch	Model 1				Model 4			
	From	To	Difference	Percentage increase	From	To	Difference	Percentage increase
A. Advanced math–endorsed teachers								
Low	497.0	660.0	163.0	33	497.0	566.5	69.5	14
Low/medium	449.0	799.4	350.4	78	449.0	584.8	135.8	30
Medium/high	312.0	561.1	249.1	80	312.0	405.9	93.9	30
High	232.0	504.5	272.5	117	232.0	340.7	108.7	47
B. Class sections taught by teachers								
Low	2.2	2.9	0.7	33	2.2	2.5	0.3	14
Low/medium	1.9	3.4	1.5	78	1.9	2.5	0.6	30
Medium/high	2.0	3.6	1.6	80	2.0	2.6	0.6	30
High	1.3	2.8	1.5	117	1.3	1.9	0.6	47
C. Students per class section								
Low	25.9	34.5	8.5	33	25.9	29.6	3.6	14
Low/medium	21.4	38.1	16.7	78	21.4	27.9	6.5	30
Medium/high	19.2	34.5	15.3	80	19.2	25.0	5.8	30
High	16.9	36.5	19.5	117	16.9	25.0	8.1	47

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

APPENDIX I
STUDENT ENROLLMENT IN CORE, INTEGRATED, AND INTERACTIVE MATH COURSES

TABLE I1

Student enrollment in core, integrated, and interactive math courses

	Grade 9			Grade 10			Grade 11			Grade 12		
Course code	Total	Percentage of all grade 9 students	Percentage of grade 9 students not on track	Total	Percentage of all grade 10 students	Percentage of grade 10 students not on track	Total	Percentage of all grade 11 students	Percentage of grade 11 students not on track	Total	Percentage of all grade 12 students	Percentage of grade 12 students not on track
2001: Core math	316	1	0	2	0	0	140	0	2	35	0	1
2002: Interactive math project	585	1	0	184	0	2	366	1	5	108	0	4
2003: Integrated math	3,091	7	0	99	0	1	1,489	3	22	477	0	16
2004: Informal math integrated approach	64	0	0	0	0	0	76	0	1	41	0	1

Note: Totals are averaged across 2006/07 and 2007/08 and are rounded to whole numbers.

Source: Authors' computations using a dataset generated from multiple sources described in appendix A.

NOTES

1. "Algebra I and above" refers to required content specified in the High School Mathematics Academic Content Standards, adopted by the Oregon State Board of Education in 2009.

2. Oregon teacher licenses may include a subject-area endorsement indicating that the holder of the license has met state requirements defining competency to teach courses in that subject area. The state determines which courses are covered by each endorsement.

3. Grade 11 students enrolled in algebra I–level courses were not considered off track because they could have previously taken another algebra I–level course; similarly, grade 12 students enrolled in an algebra I–level course were not considered off track because they could have previously taken an algebra I– and a geometry-level course.

4. This is the total number of teachers teaching all of the high school math classes over the years included in this study. There might have been additional math-endorsed teachers in Oregon who were not teaching math classes in the years studied.

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