

Subtraction and Substitution: Technical Note

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In April 2026, PACE published *Subtraction and Substitution: Shifts in High School Math Coursetaking* by Dykeman et. al and *Subtraction and Substitution: School Roles in Shifts in High School Math* by Larson et. al. Both analyzed trends in California high school math coursetaking in the past decade. Analyses in these reports use state course codes to categorize math courses into eight categories (e.g., Algebra 2 or precalculus/trigonometry) to allow for meaningful interpretation of research results. The results reported in these papers may be sensitive to the researchers' choices about course categorization. As such, this technical appendix explores the robustness of the general trends presented in the two reports to changes in course categorization methods and **demonstrates that the core results are stable to changes in course categorization.**

The California Longitudinal Pupil Achievement Data System (CALPADS) data used for the reports includes state course codes for each course taken by each public high school student in the state for the 2014-15 through the 2023-24 academic years. These state course codes reflect the approximate curriculum content of each course. For example, state course code 9243 is used for Integrated Math 3 courses, while 9252 is the code for a typical standalone Algebra 2 course. There are 59 unique mathematics state course codes (excluding computer science) in the pre-2019 period, and 49 such state course codes in the post-2019 period after the California Department of Education (CDE) transitioned to a new state course code scheme in the summer of 2019.

Given the impossibility of evaluating the curriculum content for every math course offered at each high school, state course codes offer a shorthand for understanding the types of math concepts students are learning. However, course categorization using state course codes is complex for two reasons:

1. State course codes sometimes include course content that straddles multiple subject areas. For example, course code 9253 (Algebra 2 and Trigonometry) includes both Algebra 2 and precalculus/trigonometry concepts. The PACE reports categorized each pre-2019 course code into a single category based on the advice of curriculum experts. However, some courses could reasonably be included in multiple categories.
2. The summer 2019 change in state course code scheme makes creating a consistent time series of courses somewhat difficult. Dykeman et al. and Larson et al. used a state course code crosswalk provided by the California Department of Education, but the crosswalk was an imperfect map for some course codes.

Because of the substantial (and increasing) overlap in course content between Algebra 2, IM 3, precalculus/trigonometry, and other advanced college preparatory math courses, these are the most common course categories impacted by potential changes in course classification schemes. Other courses, including statistics, calculus, and prerequisites to Algebra 2 and IM 3, are easier to consistently sort over time based on state course codes.

There are two primary ways to test the sensitivity of results to variations of the course categorizations provided in the main reports. First, it is possible to re-bin entire course codes from one category into another. The second is to use the *local course name* provided for each course in the CALPADS system to make additional inferences about course content. Exploiting these methods, this technical appendix explores the sensitivity of the main results through additional analyses that include eight different possible alternative categorizations of math courses:

1. **Baseline:** Baseline categories as described in Dykeman et. al and used in Larson et al.
2. **Re-Bin 9253:** This analysis re-categorizes state course code 9253 (Algebra 2 and Trigonometry) into the precalculus/trigonometry category from the baseline Algebra 2 category. A similar course code before the 2019 course code change (2408— Intermediate Algebra and Trigonometry) was included in the precalculus/trigonometry baseline category. This re-bin creates a more internally consistent time series of precalculus/trigonometry enrollment.
3. **Re-Bin Post-2020 IB Courses:** In 2020, the International Baccalaureate (IB) re-designed their 11th and 12th grade-level math courses. In the baseline analysis, pre-2020-21 IB courses (2460, 2461, 2462, 2463, 9269, 9270, 9271, and 9272) were categorized as *other*, while post-2020-21 IB courses (9281, 9282, 9283, and 9284) were categorized as precalculus/trigonometry. This analysis re-bins these post-2020-21 upper level IB courses into *other* from the baseline precalculus/trigonometry category. One could easily argue that the re-designed IB courses are more accurately categorized as *other* instead of precalculus/trigonometry.
4. **Time Consistent Re-Bins:** This analysis combines the *Re-Bin 9253* and *Re-Bin Post 2020 IB Courses* analyses. The combination of these two adjustments creates the most time-consistent combination of course categorizations that we present.
5. **Re-Bin Some 9273:** This analysis sorts courses with state course codes 9273 and 2490 (College Credit Course - Mathematics) into the precalculus/trigonometry from the *other* category. However, this is only done for courses with local course names that imply precalculus or above level

coursework. This includes college credit courses with names that include variations of the keywords: “calculus”, “trig”, “analysis”, “linear”, “differential equations”, etc. Although most college credit courses are not precalculus/trigonometry specifically, a huge number fall into the *precalculus or above* category (precalculus/trigonometry or calculus), which is how precalculus enrollment by graduation is defined in Dykeman et al. Figure 9.¹ This category does not capture college credit courses with ambiguous local course names (e.g. “MATH 100”). Moreover, this categorization only captures dual credit coursework tracked and reported by high schools in CALPADS; it does not account for all college mathematics courses in which high school students may enroll (i.e., independent dual enrollment).

6. **Re-Bin Some IM 3:** This analysis re-categorizes some Integrated Math 3 (IM 3) courses from the Algebra 2 to the precalculus/trigonometry category. This includes classes with state course codes 2427, 2442, and 9243. Advanced or accelerated IM 3 courses often include trigonometry concepts, and schools sometimes allow students to use these accelerated IM 3 courses as a prerequisite for calculus courses without an official precalculus course. Here, IM 3 courses with variations of the key terms “H”, “precalc”, “trig”, “honors”, “advanced”, “accelerated”, “plus”, “STEM”, “enhanced”, etc. are binned with precalculus/trigonometry courses.
7. **Re-Bin IM 4:** Here, Integrated Math 4 (IM 4) is categorized as precalculus/trigonometry instead of the *other* category it was in at baseline. This includes state course codes 2430, 2443, and 9244.
8. **All Re-Bins:** This analysis combines all re-categorizations described above.

The tables below summarize the baseline categorizations of the impacted courses as well as the alternative course categorization schemes.

¹ This would also move these college credit courses to precalculus/trigonometry from the *other* category for Dykeman et al.’s analysis of 12th grade course-taking, as well as for Larson et al.’s analysis on school course offerings. In these analyses, precalculus/trigonometry is not defined as precalculus *or above*. Therefore, this re-binning should primarily be read as a robustness check for Dykeman et al.’s findings on precalculus/trigonometry or above enrollment by graduation.

Table: Baseline Course Categorizations

State Course Code	Pre-or-Post 2019	State Course Name	Baseline Course Category
2427	Pre-2019	Integrated mathematics III college prep	Algebra 2 or Similar
2430	Pre-2019	Integrated Mathematics IV (college preparatory)	Other
2442	Pre-2019	Integrated Mathematics III – Common Core	Algebra 2 or Similar
2443	Pre-2019	Integrated Mathematics IV – Common Core	Other
2490	Pre-2019	College Credit Course - Mathematics	Other
9243	Post-2019	Integrated Mathematics III	Algebra 2 or Similar
9244	Post-2019	Integrated Mathematics IV	Other
9253	Post-2019	Algebra II and Trigonometry	Algebra 2 or Similar
9273	Post-2019	College Credit Course - Mathematics	Other
9281	Post-2019	International Baccalaureate (IB) Mathematics: analysis and approaches SL	Other
9282	Post-2019	International Baccalaureate (IB) Mathematics: analysis and approaches HL	Other
9283	Post-2019	International Baccalaureate (IB) Mathematics: applications and interpretation SL	Other
9284	Post-2019	International Baccalaureate (IB) Mathematics: applications and interpretation HL	Other

Note: The Pre-or-Post 2019 column indicates if a course code comes from the CDE course code scheme used prior to the summer of 2019 (pre-2019), or the CDE course code scheme used after the summer of 2019 (post-2019).

Table: Alternative Course Categorizations

Re-Bin	Course Codes Moved	Category From	Category To	All or Some?
Baseline	N/A	N/A	N/A	N/A
Re-Bin 9253	9253	Algebra II	Precalculus/Trig	All
Re-Bin Post 2020 IB Courses	9281, 9282, 9283, 9284	Precalculus/Trig	Other	All
Time Consistent Re-Bins	9253, 9281, 9282, 9283, 9284	9253: Algebra 2; 9281–9284: Precalculus/Trig	9253: Precalculus/Trig; 9281–9284: Other	All
Re-Bin Some 9273	9273, 2490	Other	Precalculus/Trig	Some (local course name implies precalculus or above: "calculus", "trig", "analysis", "linear", "differential equations", etc.)
Re-Bin Some IM 3	2427, 2442, 9243	Algebra 2	Precalculus/Trig	Some (local course name implies advanced/accelerated: "H", "honors", "advanced", "accelerated", "precalc", "trig", "plus", "STEM", "enhanced", etc.)
Re-Bin IM 4	2430, 2443, 9244	Other	Precalculus/Trig	All
All Re-Bins	9253; 9281, 9282, 9283, 9284; 9273, 2490; 2427, 2442, 9243; 2430, 2443, 9244	See individual re-bins above	See individual re-bins above	All and Some (see individual re-bins above)

The sections below discuss any differences in results for each relevant alternative categorization scheme by figure from for the two reports. See each report for more information on data and sample construction. See the final section of this appendix for the table version of each figure.

Dykeman et al. Figure 2

Figure 2 in Dykeman et al. displays the percentage of 12th graders who take each of the eight different types of math courses offered in California public high schools. When considering alternative binning schemes, 12th grade math enrollment patterns are stable across course categorization alternatives. The type of math courses taken by 12th graders over time fluctuates by no more than 2.5 percentage points for each course in any academic year under any pair of alternative course classifications. Most notably, re-categorizing IM 4 from the *other* category to precalculus/trigonometry boosts 12th grade precalculus/trigonometry enrollment by about 1-1.25 percentage points after 2019, along with a corresponding drop in *other* enrollment. Additionally, re-binning IB course codes from the precalculus to the *other* category results in an approximately one percentage point drop in precalculus/trigonometry enrollment post-2020.

All other adjustments, including re-binning 9253 (Algebra 2 and Trigonometry), some of 9273 (College Credit Math), and some IM 3 courses to the precalculus/trigonometry categories cause fluctuations of no more than one percentage point above or below Dykeman et al.'s baseline estimates. Combining all possible re-bins results in changes to enrollment of at most 2.5 percentage points for precalculus/trigonometry and a percentage point for Algebra 2 in any given year.

Figure 1A: 12th Grade Precalculus/Trigonometry Enrollment

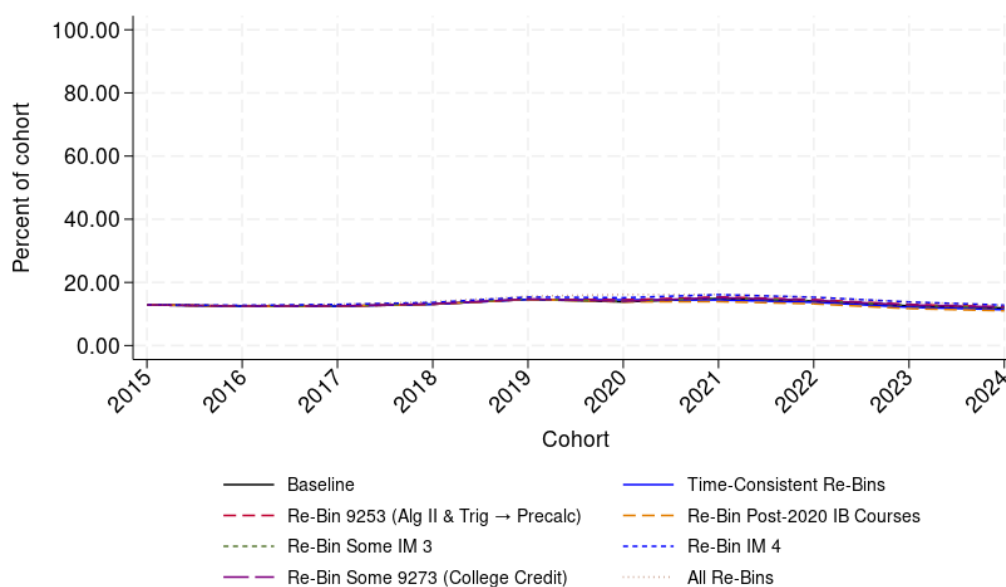
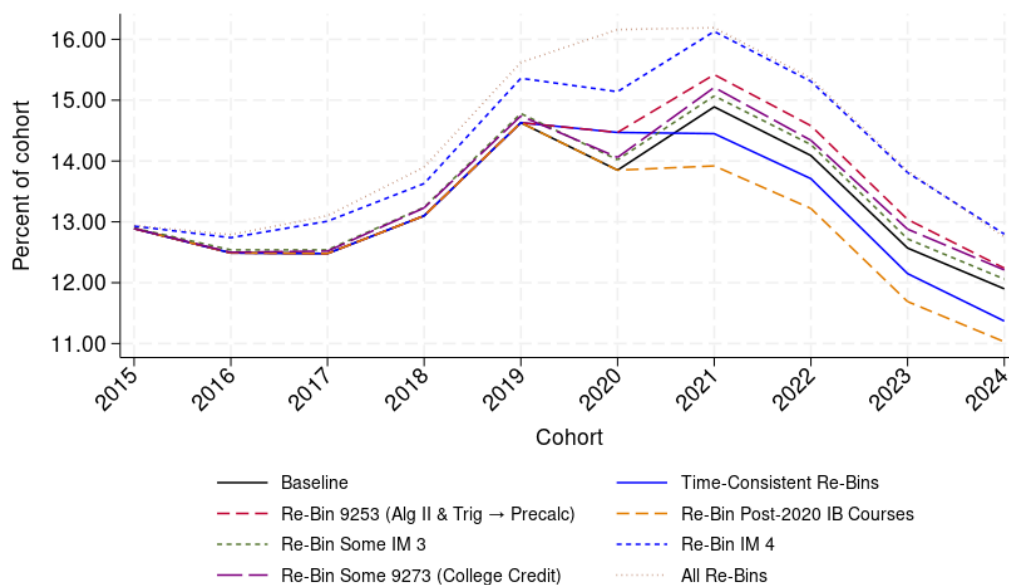
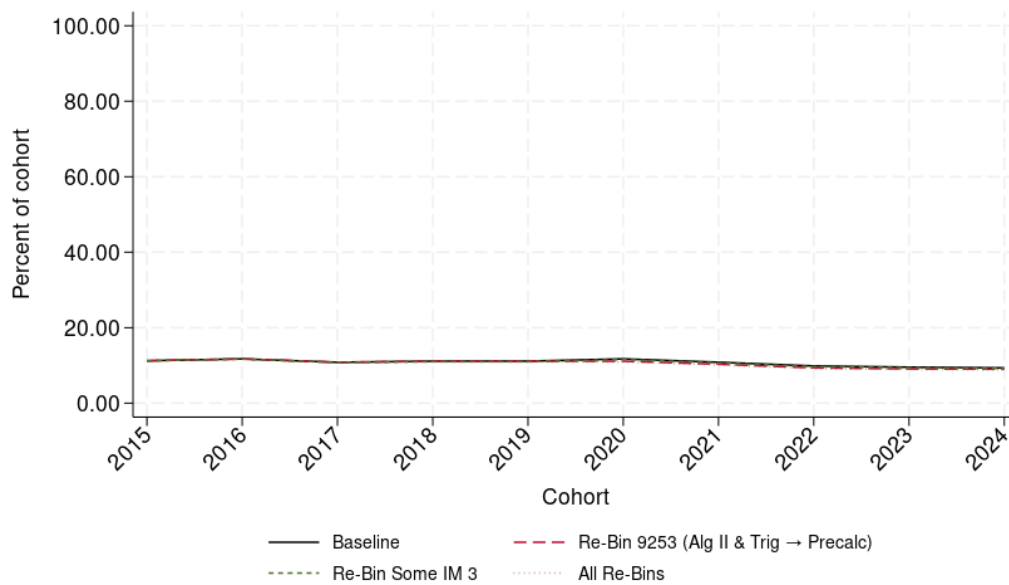
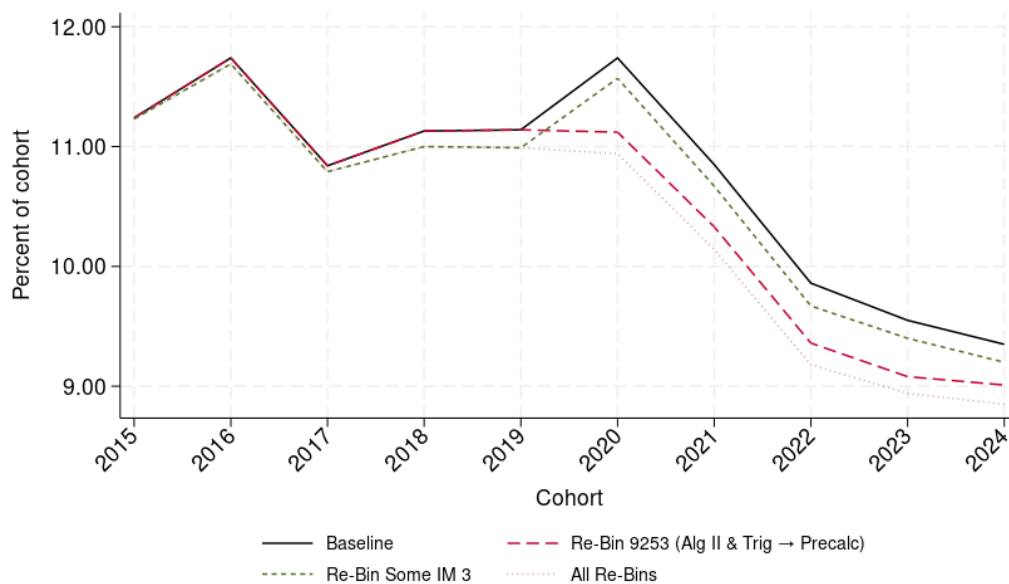


Figure 1B: 12th Grade Precalculus/Trigonometry Enrollment (Zoomed In)

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the precalculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Figure 2A: 12th Grade Algebra 2 Enrollment*Figure 2B: 12th Grade Algebra 2 Enrollment (Zoomed In)*

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), and all of the above combined (All Re-Bins).

Figure 3A: 12th Grade Other Enrollment

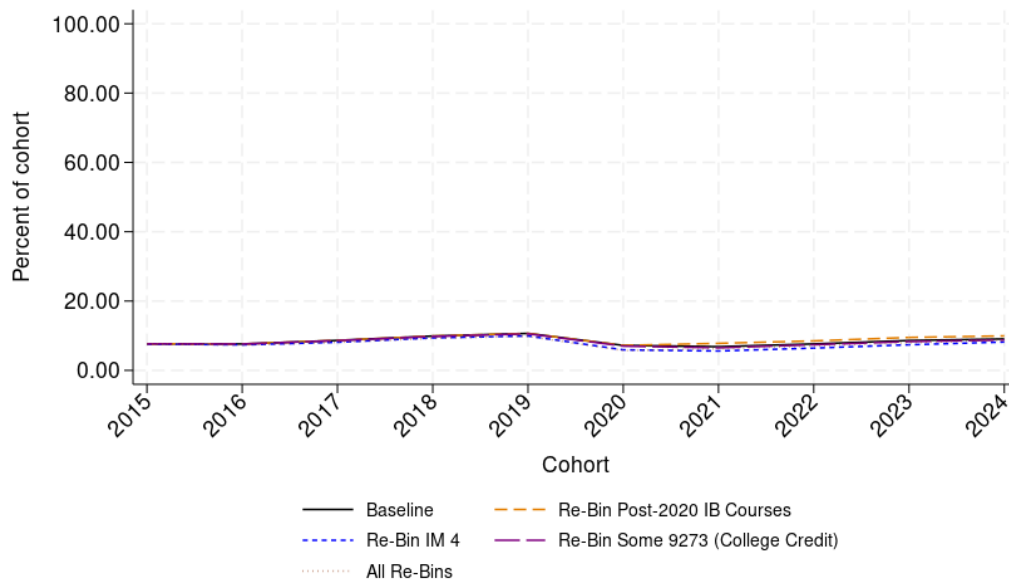
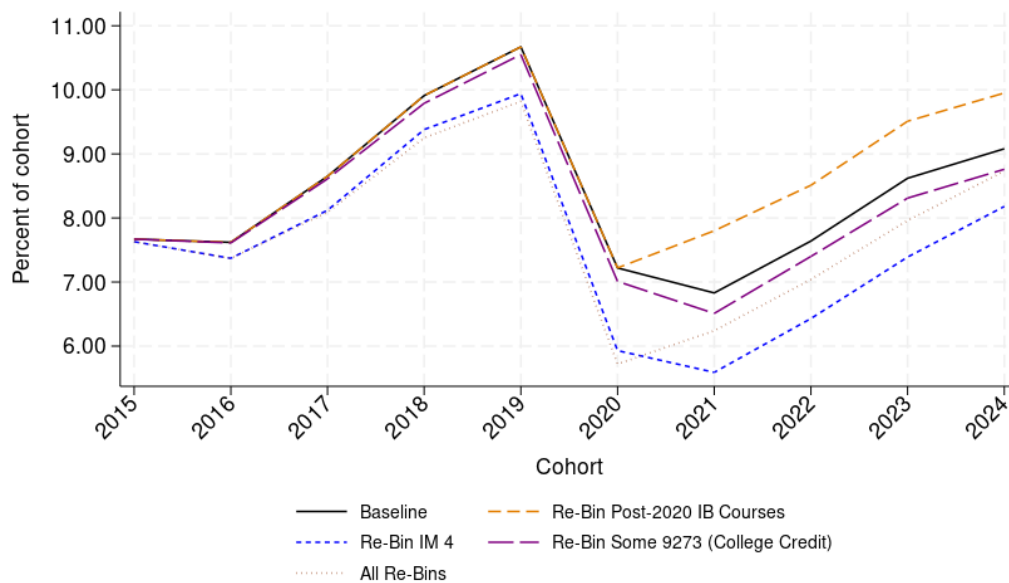


Figure 3B: 12th Grade Other Enrollment (Zoomed In)



Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Dykeman et al. Figures 7 and 9

Figure 7 in Dykeman et al. shows that about 75% of students take Algebra 2 before graduation, a proportion which is relatively stable over time and throughout all eight binning schemes. Dykeman et al. Figure 9 shows the percentage of students who take precalculus or calculus before graduation. The authors find a 12.5 percentage point drop in precalculus/trigonometry (or above) enrollment by graduation over the past 8 years. This downward trend in precalculus/trigonometry course enrollment is robust to alternative course categorization schemes. While the magnitude of the decline changes slightly depending on the course classification scheme used, it is above 9.5 percentage points for all eight binning schemes. In any given cohort, there is up to a 5.1 percentage point difference in the rate of precalculus/trigonometry enrollment between course categorization alternatives, with the largest differences being between the Post-2020 IB Re-bin and All Re-Bins combined schemes in 2023. Gaps in precalculus/trigonometry enrollment between course categorization schemes have grown slightly over time because of the increase in IM enrollment since 2017.

Figure 4A: Ever Took Algebra 2 or Above (Figure 7)

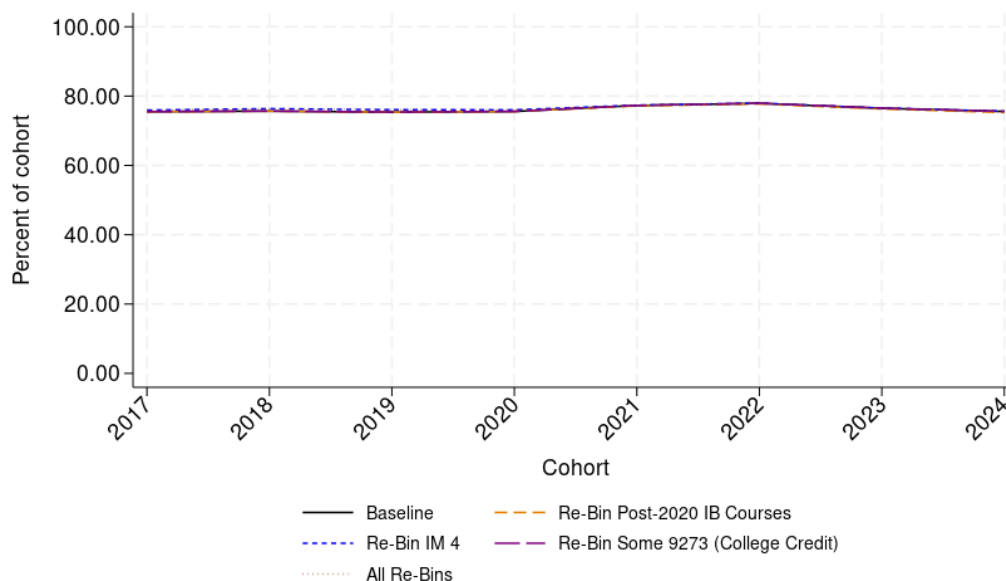
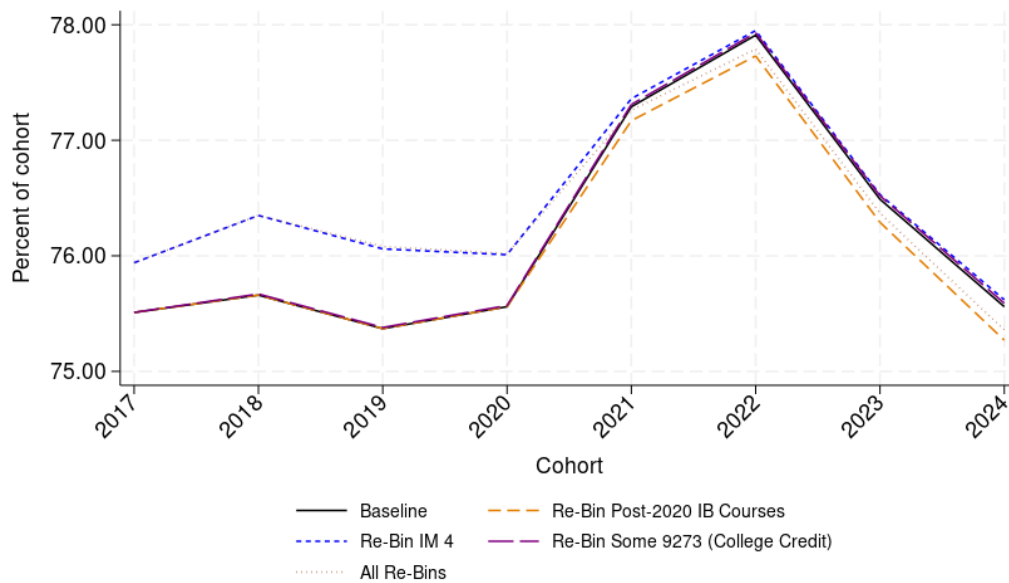


Figure 4B: Ever Took Algebra 2 or Above (Zoomed In)

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), IB courses 9281–9284 moved from the precalculus/trigonometry to other category (Re-Bin Post-2020 IB Courses), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins). Course categorization alternatives that move courses from Algebra 2 to precalculus will not change the rate of Algebra 2 or above coursetaking by graduation. Categorizations that move courses into and out of the *other* category from precalculus will change the Algebra 2 or above coursetaking and are shown here

Figure 5A: Ever Took Precalculus/Trigonometry or Above (Dykeman et al. Figure 9)

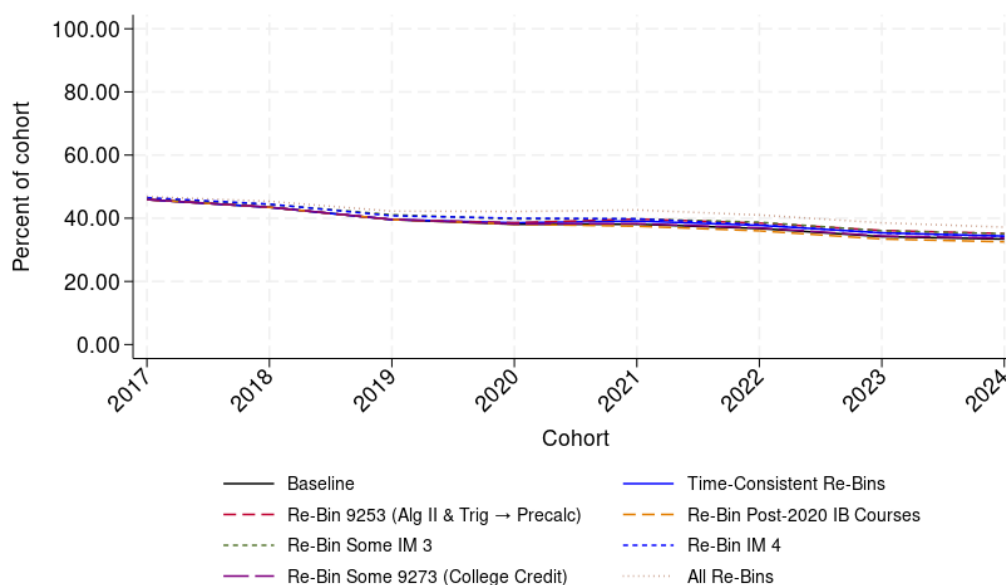
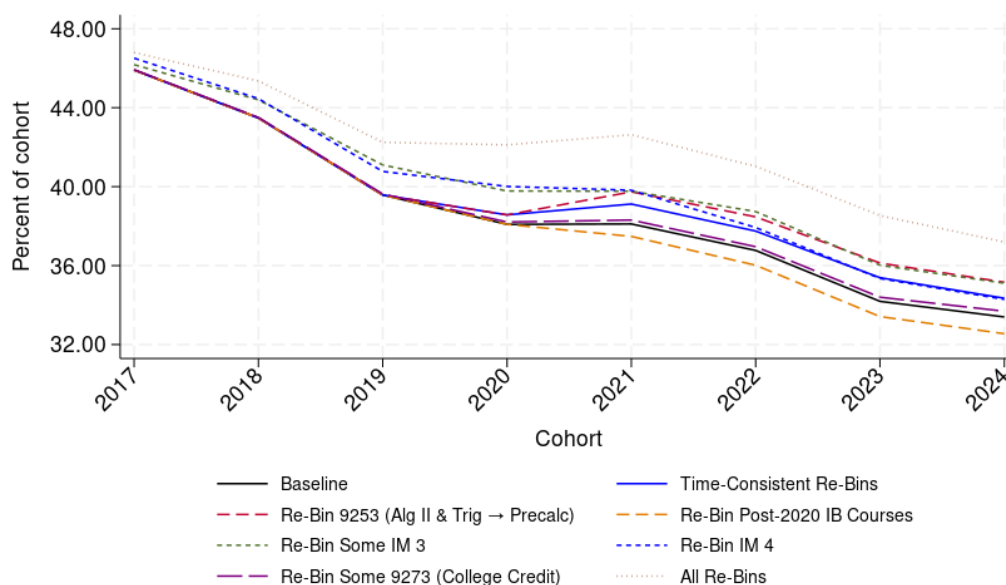


Figure 5B: Ever Took Precalculus/Trigonometry or Above (Zoomed In)

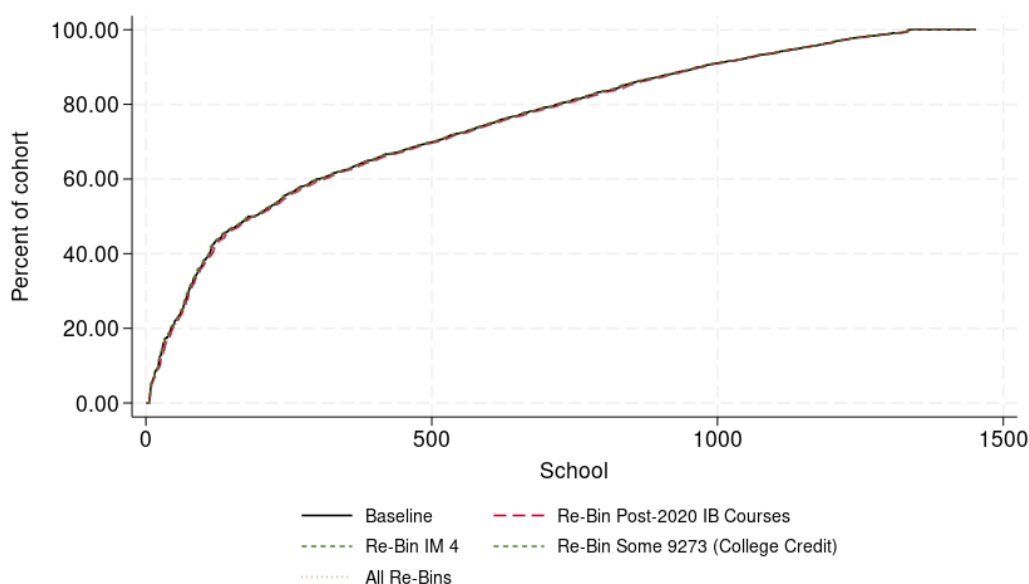


Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. Only students with 4 years of course taking data are included. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Larson et al. Figure 4

Larson et al. Figure 4 shows the distribution of Algebra 2 or above enrollment by graduation across schools. It includes a data point for each public high school in the sample. While the relative ordering of schools based on Algebra 2 (or above) enrollment changes slightly across categorization schemes, the overall distribution of Algebra 2 enrollment rates across schools is steady across all course categorization alternatives.

Figure 6: School-level Algebra 2 or Above Completion



Note: Includes students in the 2024 graduation cohort, defined as those enrolled in 12th grade on April 15th, 2024. This figure only includes schools with traditional school ownership codes (SOCs 65–67) that had at least 15 seniors with four years of course-completion data in 2024. The course categorization alternatives shown include those from Larson et al. (Baseline), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins). Course categorization alternatives that move courses from Algebra 2 to precalculus will not change the rate of Algebra 2 or above coursetaking by graduation. Categorizations that move courses into and out of the *other* category from precalculus will change the Algebra 2 or above coursetaking and are shown here

Larson et al. Figure 6

Results involving observed school-level course offerings change slightly under different course classification schemes. Most notably, sorting some advanced IM 3 courses into the precalculus/trigonometry bucket nearly erases the slight decline in precalculus/trigonometry offerings seen between 2015 and 2018. This implies that some schools could be offering advanced IM 3 courses as an alternative to traditional precalculus/trigonometry courses. However, rebinning IM 3 or Algebra 2 and Trigonometry (9253) courses offsets small gains observed in Algebra 2 offerings over time.

Figure 7A: School Precalculus/Trigonometry Offerings

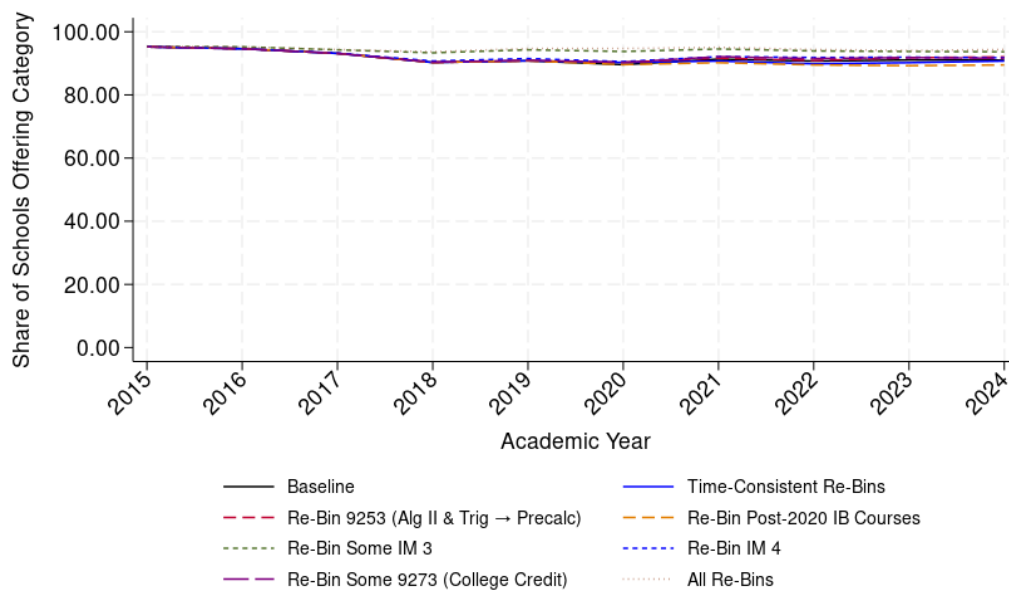
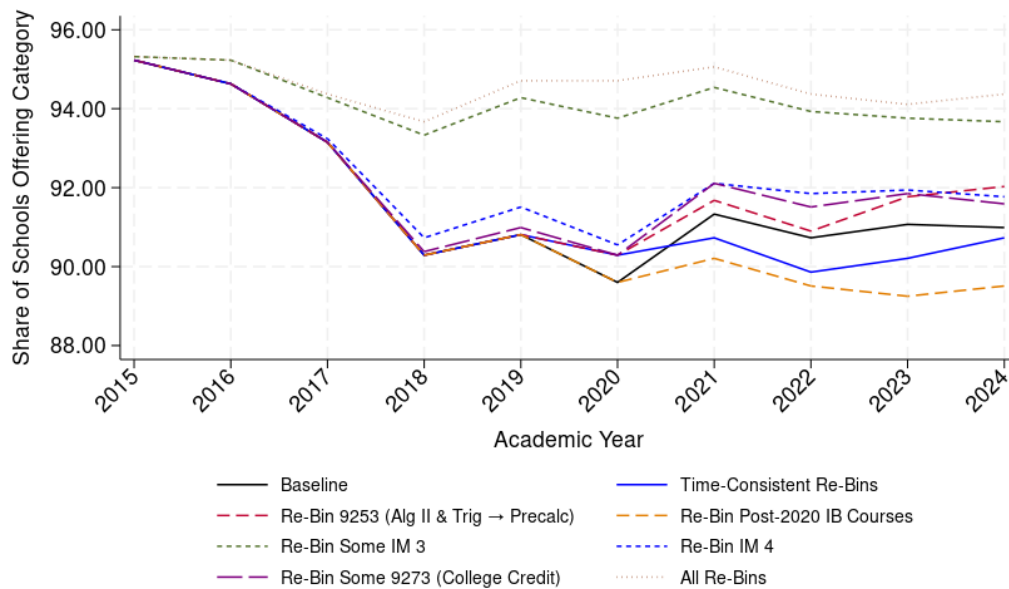
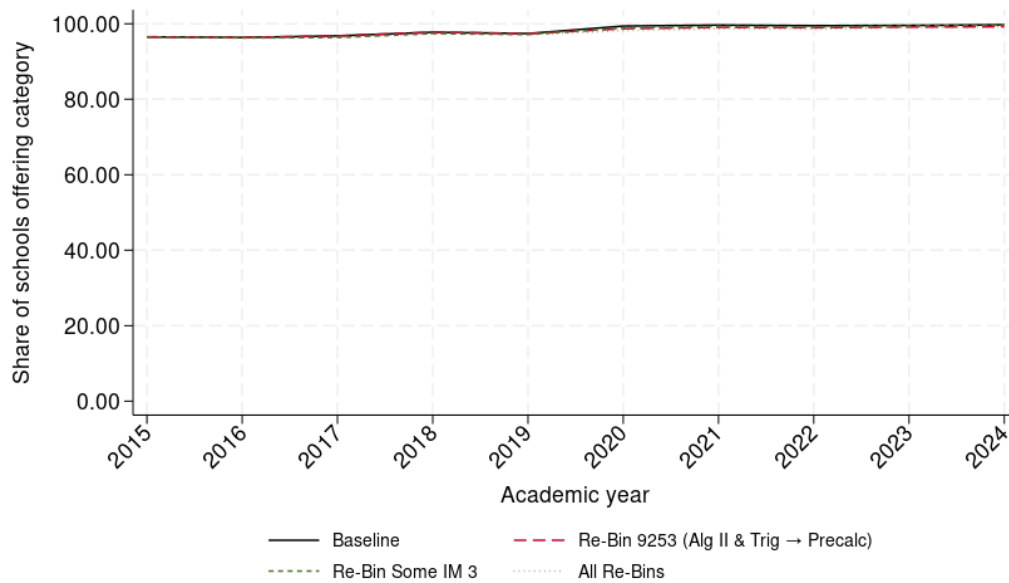
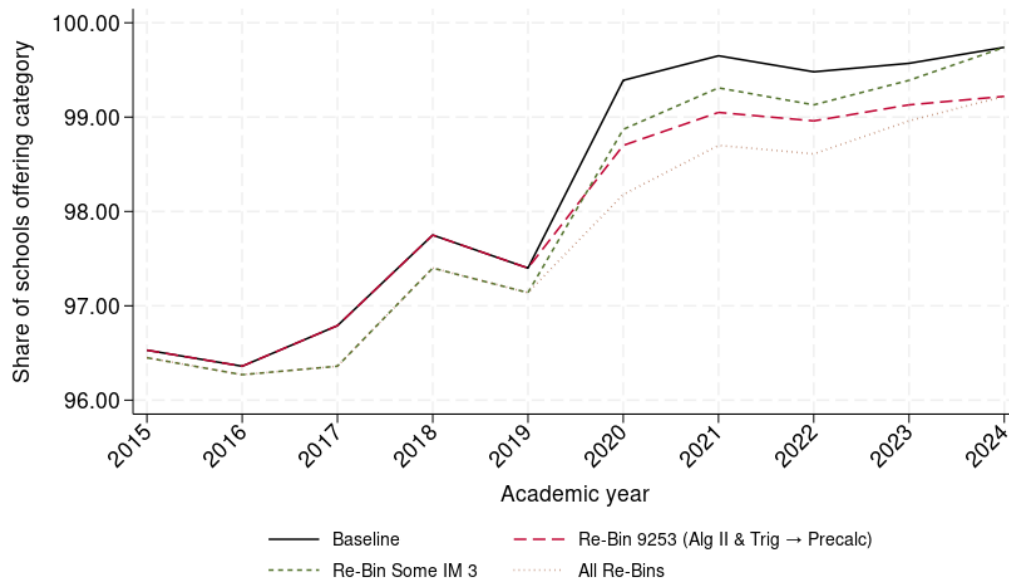


Figure 7B: School Precalculus/Trigonometry Offerings (Zoomed In)

Note: This figure shows the percentage of schools with at least one student enrolled in precalculus/trigonometry under various course-categorization schemes. It only includes schools with traditional school ownership codes (SOCs 65–67) that had at least 15 seniors for all years from 2014 through 2024. The course categorization alternatives shown include those from Larson et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Figure 8A: School Algebra 2 Offerings*Figure 8B: School Algebra 2 Offerings (Zoomed In)*

Note: This figure shows the percentage of schools with at least one student enrolled in Algebra 2 or trigonometry under various course-categorization schemes. It only includes schools with traditional school ownership codes (SOCs 65–67) that had at least 15 seniors for all years from 2014 through 2024. The course categorization alternatives shown include those from Larson et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/ trigonometry category (Re-Bin 9253), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), and all of the above combined (All Re-Bins).

Tables

Table 1: 12th Grade Precalculus/Trigonometry Enrollment (Dykeman et al. Figure 2)

Cohort	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2015	12.89	12.90	12.93	12.89	12.89	12.89	12.94	12.89
2016	12.49	12.54	12.74	12.50	12.49	12.49	12.79	12.49
2017	12.48	12.54	13.01	12.52	12.48	12.48	13.10	12.48
2018	13.10	13.24	13.63	13.23	13.10	13.10	13.90	13.10
2019	14.63	14.78	15.36	14.74	14.63	14.63	15.62	14.63
2020	13.85	14.02	15.14	14.06	14.47	13.85	16.16	14.47
2021	14.89	15.07	16.13	15.21	15.42	13.92	16.19	14.45
2022	14.09	14.27	15.31	14.34	14.58	13.22	15.36	13.71
2023	12.57	12.72	13.81	12.88	13.04	11.69	13.84	12.15
2024	11.90	12.06	12.80	12.21	12.24	11.03	12.75	11.37

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 2: 12th Grade Algebra 2 Enrollment (Dykeman et al. Figure 2)

Cohort	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2015	11.24	11.23	11.24	11.24	11.24	11.24	11.23	11.24
2016	11.74	11.69	11.74	11.74	11.74	11.74	11.69	11.74
2017	10.84	10.79	10.84	10.84	10.84	10.84	10.79	10.84
2018	11.13	11.00	11.13	11.13	11.13	11.13	11.00	11.13
2019	11.14	10.99	11.14	11.14	11.14	11.14	10.99	11.14
2020	11.74	11.57	11.74	11.74	11.12	11.74	10.94	11.12
2021	10.85	10.67	10.85	10.85	10.33	10.85	10.14	10.33
2022	9.86	9.67	9.86	9.86	9.36	9.86	9.18	9.36
2023	9.55	9.40	9.55	9.55	9.08	9.55	8.94	9.08
2024	9.35	9.20	9.35	9.35	9.01	9.35	8.85	9.01

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 3: 12th Grade Other (Dykeman et al. Figure 2)

Cohort	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2015	7.67	7.67	7.63	7.67	7.67	7.67	7.63	7.67
2016	7.62	7.62	7.37	7.61	7.62	7.62	7.37	7.62
2017	8.65	8.65	8.12	8.61	8.65	8.65	8.09	8.65
2018	9.91	9.91	9.38	9.79	9.91	9.91	9.25	9.91
2019	10.67	10.67	9.94	10.55	10.67	10.67	9.82	10.67
2020	7.22	7.22	5.93	7.01	7.22	7.22	5.72	7.22
2021	6.83	6.83	5.59	6.51	6.83	7.80	6.24	7.80
2022	7.64	7.64	6.43	7.40	7.64	8.51	7.04	8.51
2023	8.62	8.62	7.39	8.31	8.62	9.51	7.96	9.51
2024	9.08	9.08	8.18	8.76	9.08	9.95	8.73	9.95

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 4: Ever Took Algebra 2 or Above (Dykeman et al. Figure 7)

Cohort	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2017	75.51	75.51	75.94	75.51	75.51	75.51	75.94	75.51
2018	75.66	75.66	76.35	75.67	75.66	75.66	76.35	75.66
2019	75.37	75.37	76.06	75.38	75.37	75.37	76.08	75.37
2020	75.56	75.56	76.01	75.57	75.56	75.56	76.02	75.56
2021	77.29	77.29	77.36	77.31	77.29	77.17	77.26	77.17
2022	77.91	77.91	77.95	77.93	77.91	77.73	77.79	77.73
2023	76.49	76.49	76.53	76.52	76.49	76.29	76.37	76.29
2024	75.56	75.56	75.62	75.59	75.56	75.27	75.36	75.27

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 5: Ever Took Precalculus/Trigonometry or Above (Dykeman et al. Figure 9)

Cohort	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2017	45.91	46.18	46.51	45.93	45.91	45.91	46.79	45.91
2018	43.48	44.40	44.46	43.51	43.48	43.48	45.36	43.48
2019	39.58	41.10	40.77	39.63	39.58	39.58	42.25	39.58
2020	38.09	39.78	40.01	38.21	38.57	38.09	42.12	38.57
2021	38.11	39.77	39.82	38.31	39.74	37.48	42.63	39.12
2022	36.77	38.74	37.93	36.96	38.47	36.02	41.03	37.75
2023	34.19	36.02	35.35	34.40	36.13	33.42	38.54	35.39
2024	33.40	35.11	34.29	33.69	35.16	32.55	37.20	34.35

Note: Cohorts are defined as the students enrolled in 12th grade on April 15th of each respective year. The course categorization alternatives shown include those from Dykeman et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/ trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 6: School Algebra 2 Offerings (Larson et al. Figure 6)

Academic Year	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2015	96.53	96.45	96.53	96.53	96.53	96.53	96.45	96.53
2016	96.36	96.27	96.36	96.36	96.36	96.36	96.27	96.36
2017	96.79	96.36	96.79	96.79	96.79	96.79	96.36	96.79
2018	97.75	97.40	97.75	97.75	97.75	97.75	97.40	97.75
2019	97.40	97.14	97.40	97.40	97.40	97.40	97.14	97.40
2020	99.39	98.87	99.39	99.39	98.70	99.39	98.18	98.70
2021	99.65	99.31	99.65	99.65	99.05	99.65	98.70	99.05
2022	99.48	99.13	99.48	99.48	98.96	99.48	98.61	98.96
2023	99.57	99.39	99.57	99.57	99.13	99.57	98.96	99.13
2024	99.74	99.74	99.74	99.74	99.22	99.74	99.22	99.22

Note: Includes students in the 2024 graduation cohort, defined as those enrolled in 12th grade on April 15th, 2024. This figure only includes schools with traditional school ownership codes (SOCs 65–67) that had at least 15 seniors with four years of course-completion data in 2024. The course categorization alternatives shown include those from Larson et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).

Table 7: School Precalculus/Trigonometry Offerings (Larson et al. Figure 6)

Academic Year	Baseline	IM 3	IM 4	College Credit	9253	IB	All	Time-Consistent
2015	95.23	95.32	95.23	95.23	95.23	95.23	95.32	95.23
2016	94.63	95.23	94.63	94.63	94.63	94.63	95.23	94.63
2017	93.15	94.28	93.24	93.15	93.15	93.15	94.37	93.15
2018	90.29	93.33	90.73	90.38	90.29	90.29	93.67	90.29
2019	90.81	94.28	91.51	90.99	90.81	90.81	94.71	90.81
2020	89.60	93.76	90.55	90.29	90.29	89.60	94.71	90.29
2021	91.33	94.54	92.11	92.11	91.68	90.21	95.06	90.73
2022	90.73	93.93	91.85	91.51	90.90	89.51	94.37	89.86
2023	91.07	93.76	91.94	91.85	91.77	89.25	94.11	90.21
2024	90.99	93.67	91.77	91.59	92.03	89.51	94.37	90.73

Note: Includes students in the 2024 graduation cohort, defined as those enrolled in 12th grade on April 15th, 2024. This figure only includes schools with traditional school ownership codes (SOCs 65–67) that had at least 15 seniors with four years of course-completion data in 2024. The course categorization alternatives shown include those from Larson et al. (Baseline), state course code 9253 moved from the Algebra 2 to the precalculus/trigonometry category (Re-Bin 9253), IB courses 9281–9284 moved from the precalculus/trigonometry to *other* category (Re-Bin Post-2020 IB Courses), the combination of all of the above (Time Consistent Re-Bins), some IM3 courses moved from Algebra 2 to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin some IM 3), IM 4 math course moved from *other* to the pre-calculus/trigonometry category (Re-bin IM 4), some 9273 courses moved from *other* to precalculus/trigonometry based on the course content implied by the local course names (Re-Bin Some 9273), and all of the above combined (All Re-Bins).