NOVEMBER 2022

A LOOK AT CALIFORNIA STATE UNIVERSITY ADMISSIONS REQUIREMENTS

How an Additional Quantitative Reasoning Course Could Affect Student Access and Success

SUSAN SEPANIK, ALYSSA RATLEDGE, ANDREA SHANE, MICHELLE DIXON, AND AMANDA MARTIN-LAWRENCE

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BUILDING KNOWLEDGE TO IMPROVE SOCIAL POLICY

FUNDERS

Funding for this study and report came from the California State University, which contracted with MDRC to conduct an independent third-party evaluation of the proposed policy change. The California Department of Education waived fees for their data provision.

Dissemination of MDRC publications is supported by the following organizations and individuals that help finance MDRC's public policy outreach and expanding efforts to communicate the results and implications of our work to policymakers, practitioners, and others: The Annie E. Casey Foundation, Arnold Ventures, Charles and Lynn Schusterman Family Foundation, The Edna McConnell Clark Foundation, Ford Foundation, The George Gund Foundation, Daniel and Corinne Goldman, The Harry and Jeanette Weinberg Foundation, Inc., The JPB Foundation, The Joyce Foundation, The Kresge Foundation, and Sandler Foundation.

In addition, earnings from the MDRC Endowment help sustain our dissemination efforts. Contributors to the MDRC Endowment include Alcoa Foundation, The Ambrose Monell Foundation, Anheuser-Busch Foundation, Bristol-Myers Squibb Foundation, Charles Stewart Mott Foundation, Ford Foundation, The George Gund Foundation, The Grable Foundation, The Lizabeth and Frank Newman Charitable Foundation, The New York Times Company Foundation, Jan Nicholson, Paul H. O'Neill Charitable Foundation, John S. Reed, Sandler Foundation, and The Stupski Family Fund, as well as other individual contributors.

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CONTENTS

LIST OF EXHIBITS

TABLES

LIST OF EXHIBITS *(CONTINUED)*

TABLES

LIST OF EXHIBITS *(CONTINUED)*

TABLES

FIGURES

BOX

ACKNOWLEDGMENTS

Many people supported this evaluation and the creation of this report. First and foremost, we would like to extend our deep thanks to all the students, teachers, school counselors, principals, school district administrators, California Department of Education (CDE) staff members, California State University (CSU) mathematics faculty, CSU mathematics deans, and CSU enrollment staff members across California who participated in interviews. Many of the interviewees went the extra mile and helped recruit others at their districts, schools, and campuses to participate and we are extra grateful for this additional support. Thanks to all these people lending their time and sharing their insights, the study team was better able to make sense of the data and capture the perceptions, concerns, and suggestions of those who would be most affected by the proposed policy change.

We are also extremely grateful to staff members at several of the CSU campuses who took time out of their busy schedules to identify, contact, and recruit CSU students to participate. Without these efforts, the study would not have been able to capture some of the most important perspectives, those of the students. Thanks especially to: Nicole A. Hawkes and Cecilia Santiago-González from Cal Poly Pomona; David Dufault-Hunter and Kimberly Parker from CSU Northridge; Tramaine Austin-Dillon from Sonoma State; Julie Lappin and Paz Maya Olivérez from CSU San Bernardino; Derek Aitken and Suzanne Espinoza from Cal State East Bay; Danielle García from CSU Fullerton; Kristin Jordan and Matthew Zivot from CSU Channel Islands; Diana Ralls from Fresno State; Beth Lesen from CSU Long Beach; and Viviana Garcia from CSU San Marcos.

We are also grateful for the deep support of the CSU Chancellor's office. James T. Minor and Edward Sullivan supported the study from its inception, providing us with advice, connecting us with the key interested parties, and sharing important documentation to help us understand the context. Additional thanks go to Edward Sullivan for providing us with the data and reviewing our report drafts. Other staff members, including Marquita Grenot-Sheyer, Nathan Evans, and Lori Putnam, provided us with support along the way.

The data analyses using the California Longitudinal Pupil Achievement Data System (CALPADS) were an important part of this work. Many thanks to the CDE for providing access to CALPADS. We especially want to thank Jonathan Isler who led us through the entire data collection process with great dedication and kindness and Sichan Kanyavong who compiled a large and rich data set for us and patiently answered all our questions. We also are grateful to Jonathan Isler and many of his colleagues for reviewing draft analyses and reports including Cindy Kazanis, Glenn Miller, Allegra Alessandri Pfeifer, Peter Callas, Paula Mishima, and Malia Vella.

This study further benefitted from the feedback and advice provided by the CSU Steering Committee on Academic Preparation and Quantitative Reasoning, which has included the following members during the study: Chris Steinhauser, Romey Sabalius, Tony Thurmond, Sara Noceto, Ben Chida, Nichole Muñoz-Murillo, Alma Barreras, Lande Ajose, Linda Darling-Hammond, Ilene Straus, Aileen Allison-Zarea, Cynthia Glover Woods, Robert Keith Collins, Marty Alvarado, Alondra Esquivel Garcia, Fabiola Moreno

Ruelas, Dixie Samaniego, Elisha Smith Arrillaga, Christopher Nellum, Mary Barlow, and Wendy Fong. We want to further thank Mary Barlow for her outreach support during our recruitment efforts.

Many MDRC staff and subcontractors also supported the project. Special thanks to Elizabeth Nelson and Helen Chen for their dedication and thoughtfulness throughout the qualitative data collection and analyses, and to Pei Zhu for providing her methodological expertise throughout the project. Thanks to resource manager, Lauren Scarola, and to Miki Shih for her support with quantitative data processing. Katie Beal, Oscar Cerna, William Corrin, John Hutchins, and Pei Zhu all provided insightful feedback on earlier drafts. A big thanks to Bryce Marshall for expert report coordination throughout the writing and editing phase and to Julia Walsh for jumping in to help with factchecking during her first few weeks at MDRC. Finally, thanks to Luisa LaFleur, who edited the report, and Ann Kottner and Carolyn Thomas, who prepared it for publication.

The Authors

EXECUTIVE SUMMARY

For the past several years, the California State University (CSU) has been investigating a proposal to add one year of high school quantitative reasoning coursework to the current CSU first-year admissions requirements, often referred to as A-G courses. Qualifying quantitative reasoning courses would include courses in mathematics (area C), science (area D), and quantitative reasoning-focused college preparatory electives (area G) and would require a grade of C- or better. In January 2020, the CSU Board of Trustees commissioned a third-party, independent analysis of the planned implementation and potential impact of the proposed requirement. MDRC is conducting this analysis with the goal of better understanding the potential effects the proposed policy change might have on students' access to and success at the CSU, particularly for students from backgrounds that are historically underrepresented at universities, including Black and Latinx students and students from families with low incomes. The study further explores the capacity of school districts and high schools across the state to implement the proposed policy change in a way that ensures equity across student groups and identifies supports and resources that may be needed for effective implementation. The study includes both a qualitative analysis of interview data collected from interested parties across the state and a quantitative analysis of student- and school-level records collected from the California Department of Education (CDE) and the CSU.

The study report includes the following key findings:

- **CSU Access:** Nearly all high school graduates (94 percent), CSU applicants (97 percent), and CSU enrollees (97 percent) who met A-G course requirements also took and passed (with a grade of C- or better) an additional quantitative reasoning course that would fulfill the proposed additional requirement even though this requirement is not in place. This suggests that the policy change would not limit access to the CSU for most students currently prepared to attend the CSU. While this is true, there are a considerable number of high school graduates who do not meet current A-G course requirements (40 percent), and over two-thirds of these students do not meet the mathematics or science requirement specifically. The vast majority of CSU applicants and enrollees meet A-G course requirements.

- **CSU Success:** While the proposed requirement may only affect the actions of a relatively small number of students who meet A-G course requirements but do not currently meet the proposed additional requirement, taking and passing an additional quantitative reasoning course may support these students' success later in college. Students who passed an additional quantitative reasoning course in high school were more likely to pass their first college-level mathematics course and students who passed a quantitative reasoning course during senior year of high school were more likely to attain a degree, and much more likely to attain a science, technology, engineering, or mathematics (STEM) degree from the CSU.[1]

1 Due to data availability, the study team was not able to look at associations between CSU degree attainment and passing an additional quantitative reasoning course in high school beyond the A-G course requirements.

- **Potential Differential Effects**: Disparities in the percentage of students meeting the current A-G course requirements exist across almost all the subgroups explored, including for Black and Latinx students, students from families with low incomes, students from rural areas and small towns, students whose parents did not attend college, and English learners. The proposed additional requirement is unlikely to diminish or intensify these disparities. For the small group of students that did not meet the proposed additional quantitative reasoning requirement (about 6 percent of high school graduates), similar disparities were found across groups as were found for those students who do not meet the current A-G course requirements. Disparities in college outcomes also exist between student groups but taking an additional quantitative reasoning class is associated with better college outcomes for most groups.

- **Staff and Student Attitudes:** Most respondents held mixed views of the proposed policy change. Nearly all respondents thought that this policy had the potential to improve students' ability to pass college mathematics courses, but many staff members worried that some students who might have been able to succeed at the CSU might no longer be able to get in if the policy were put into place. Staff members from rural districts, high-poverty districts, and districts serving primarily students of color expressed great concern about the policy impacting their students.

- **District Capacity:** While most districts have a relatively small percentage of students who meet A-G requirements not already meeting the proposed additional requirement, there are some districts that do have larger percentages of students that do not meet the additional requirement. About 25 percent of districts across the state have more than 10 percent of their students who meet A-G not currently meeting the additional requirement and about 4 percent of districts have more than 25 percent of students not meeting the additional requirement. Almost all regular public high schools offer at least one course that would meet the proposed requirement, but the variety of course offerings differ across high schools, and it is not known if districts could provide enough sections of these courses to support all interested students if the proposed change was to go into effect. Many high school and district staff members interviewed expressed concerns about the ability of their schools to provide the additional course offerings needed for students to meet the proposed requirement.

- **Resources Needed:** The biggest concern for high school and school district staff members was around the ability to find additional teachers with the proper credentialing to meet the increased course demand. They identified a need for additional funding to support recruiting and hiring additional teachers, providing professional development, and supporting credentialing of current or former teachers for the new courses. Beyond funding, district and high school staff members also noted a need for improved coordination and communication about the policy change and how to support students to meet any proposed new requirement.

NEXT STEPS AND CONSIDERATIONS

The good news coming out of this research is that the vast majority of California high school graduates that may aspire to attend the CSU are already taking and passing an additional quantitative reasoning course even though it is not currently required. During the September 2022 CSU Board of Trustees meeting, the CSU Chancellor noted a shift in her office's proposal: "instead of focusing on a change to our admission requirements, we anticipate exploring multiple strategies that prepare students with the critical skills necessary for a full range of academic pursuits and professions." If the goal is to ensure that more CSU students, and potentially more high school students in general, are taking more high-quality quantitative reasoning courses that explicitly prepare them for college and career success, it may make sense for the CSU and its partners to focus on collaboration that can help ensure those courses are provided with sufficient quality and quantity to all students and especially to those student groups who face disparities in college access.

For the past several years, the California State University (CSU) has been investigating a proposal to add one year of high school quantitative reasoning coursework to the current CSU first-year admissions requirements, often referred to as A-G courses. This proposal is part of a larger effort to increase graduation rates overall and reduce disparities in retention and graduation for students historically underrepresented at universities in California and across the country, including Black and Latinx students and students from families with low incomes.[1] The goal of the new requirement would be to ensure more students are prepared for their first college-level mathematics course with the hope that succeeding in this initial course would improve students' postsecondary completion and degree attainment (see Box 1 for more details on why the CSU Chancellor's Office proposed this policy change). The CSU's intention is not to curtail access to the CSU or change the composition of the CSU student body, though some observers, including some community-based organizations focused on educational equity, have raised concerns that the proposed policy change could act as a barrier to some students' ability to gain admission to the CSU. In particular, concerns that this change could disproportionately affect—and undermine recent progress for—students from historically underrepresented backgrounds at universities are top of mind for the CSU and other interested parties across the state.

In January 2020, the CSU Board of Trustees commissioned a third-party, independent analysis of the planned implementation and potential impact of the proposed additional requirement on high school students' applications to the CSU. Later that year, the CSU contracted with MDRC to conduct this study in an effort to better understand the potential effects the proposed policy change might have on students' college access and success, particularly for students from historically underrepresented backgrounds. The study includes both a qualitative analysis of interview data collected from interested parties across the state (such as high school teachers and counselors, school district administrators, CSU mathematics faculty, and current CSU students) and a quantitative analysis of student- and school-level records collected from the California Department of Education (CDE) and the CSU system.

This report discusses the findings from the study. Due in part to these findings, the CSU Chancellor noted, during the September 2022 CSU Board of Trustees meeting, "instead of focusing on a change to our admissions requirements, we anticipate exploring multiple strategies that prepare students with the critical skills necessary for a full range of academic pursuits and professions." While the CSU Chancellor's Office is shifting its proposed admissions changes, these study findings are still useful in informing the Board of Trustees around these new policy recommendations. The study findings may also be useful in the future if the CSU system or other entities (in California or in other states) consider similar high school graduation or college admissions policy changes.

1 The United States Census defines Latino (masculine) or Latina (feminine) as any person of "Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin." In recent years, "Latinx" has been increasingly used as a broader, gender-neutral reference to this population. This term is the preferred descriptor by the CSU Chancellor's Office unless the individual or people discussed prefer a different term. See the CSU's Diversity/Inclusivity Style Guide. Almost half of CSU students in 2021 were underrepresented minorities, including 4 percent Black students and 45 percent Latinx students. Half of the CSU students in that year received a Federal Pell Grant awarded only to undergraduate students who display exceptional financial need. See California State University Fact Book (2021).

BOX 1
WHY THIS PROPOSED POLICY?

The California State University (CSU) system has set goals that aim to increase their graduation rates and reduce equity gaps in retention and graduation. Over the past few years, the CSU has enacted several policies to try to accomplish these goals. One area of inquiry has focused on college readiness in mathematics. College mathematics has consistently been identified as a barrier to success for students nationwide, and internal CSU data indicated it was a bottleneck for CSU students as well. To deal with this issue, the CSU system made some dramatic changes to its mathematics program, most notably, removing high-stakes placement testing for incoming students and moving away from requiring non-credit developmental or remedial courses and instead offering corequisite courses to students identified as needing additional support. (In corequisite courses, students simultaneously take a college credit-bearing mathematics course paired with a support course to help them succeed.)

The proposal to add another quantitative reasoning course to the admission requirements for first-year students aimed to improve college graduation rates by better preparing students for college-level mathematics and other courses that require these reasoning skills. The proposal was also meant to improve equity in college mathematics course completion and major choices—for instance, by improving and equalizing students' mathematics backgrounds, they may have better experiences with science, technology, engineering and mathematics (STEM) courses, better preparation for college-level STEM majors, and an improved likelihood of entering STEM careers.*

*To learn more, see "Expanding Opportunity Through Preparation in Quantitative Reasoning" at https://www.calstate.edu/impact-of-the-csu/student-success/quantitative-reasoning-proposal.

The quantitative analyses suggest that almost all students who meet the current A-G course requirements already take and pass an additional quantitative reasoning course that would have likely fulfilled the proposed requirement. In 2020, 93.8 percent of public high school graduates in California (and 96.8 percent of CSU applicants) who met the current A-G course requirements also took and passed (with a grade of C- or better) at least one additional math, science, or quantitative reasoning-focused elective course during high school. These findings suggest that the proposed policy change would not have much of an impact on the high school courses that most students planning to attend CSU will take.

While the quantitative research found the gap in students who meet A-G course requirements also meeting the proposed additional requirement to be small, the qualitative research suggests that the *perceived* gap may be much larger. Many of the high school and district staff members interviewed felt that many high schools across the state would need to offer additional courses and course sections to ensure applicants to the CSU would be able to meet the proposed additional requirement and that many of these schools did not have the capacity to meet this additional need. In particular, district and high school staff members said that either hiring additional teachers or providing the credentialing and professional development for current teachers would be challenging, especially given significant teacher shortages across the state.[2]

It is possible that many of these interviewees were considering the policy change through the lens of all the students they serve and not only the students that met A-G course requirements or that applied to the CSU. While few students who meet the A-G course requirements do not also meet the additional requirement, there are still many high school graduates who do not meet the A-G course requirements and the proposed policy change could have had an unintentional effect on these students. The study found that about 40.3 percent of high school graduates currently do not meet the A-G course requirements, and most of these students are missing one or more of the required mathematics or science courses. Adding an additional quantitative reasoning course to the CSU enrollment requirements could create more distance between the course-taking of high school graduates not meeting A-G course requirements and their counterparts that meet A-G. This could be particularly problematic, for example, for a student who originally planned not to work toward meeting A-G course requirements but who decides late in high school to seek admission to the CSU.

Another reason for the difference between the quantitative and qualitative findings could be that the study team purposefully interviewed staff members from schools and districts more likely to struggle with the proposed policy change, and these interviewees may be considering the problem from their local perspective where the issue may be larger than the average across the state. Most districts across the state have relatively few students who meet the A-G requirements but do not meet the additional requirement. A district-by-district analysis showed that about 75 percent of districts had less than 10 percent of their students who met A-G course requirements not currently meeting the proposed additional requirement. Only about 4 percent of districts had more than 25 percent of their current graduates that met A-G not meeting the additional requirement.

While only 6.2 percent of students (or about 15,000 students across the state) that meet A-G course requirements do not already take and pass (with a grade of C- or better) a course that would meet the proposed additional requirement, within this small group disparities exist, including for Black and Latinx students, students from families with low incomes, students from rural areas and small towns, students whose parents did not attend college, and English learners. These differences in meeting the additional requirement among student groups correspond with the differences found in meeting A-G course requirements among the same set of student groups. While the proposed policy change might not exacerbate these disparities, without additional attention paid to these groups, the existing inequalities could continue unabated. Many of the interviewees at the school district and high school levels expressed concern that rural schools and schools in lower-income communities might be more likely to struggle with capacity issues potentially exacerbating existing equity gaps.

2 See the following for information regarding concerns about teacher shortages across California: Carver-Thomas, Kini, and Burns (2020); Carver-Thomas, Burns, Leung, and Ondrasek (2022); and Lambert, Willis, and Xie (2022).

The quantitative analysis further suggests that taking an additional quantitative reasoning course as proposed is associated with some better college outcomes, such as students' passing their first college-level mathematics course and attaining college degrees. Most of the people interviewed also felt the policy had the potential to improve students' success in college mathematics courses. While the proposed change might not have a drastic effect on average across all CSU students because most enrollees already meet the additional requirement, for the small group of students who do not currently meet the requirement, the policy change has the potential to positively affect some of their college outcomes.

PROPOSED CHANGE TO ADMISSIONS REQUIREMENTS

The proposed additional requirement would have compelled graduating high school students, beginning with the high school graduating class of 2027, to complete one additional course in quantitative reasoning to meet the minimum qualifications for first-year admission to the CSU. The current A-G course requirements include a total of 15 courses with a required three years of college-preparatory mathematics and two years of college-preparatory science (see Table 1 for current and proposed requirements). Students must meet each of the A-G course requirements with a grade of C- or better. The proposed additional quantitative reasoning requirement could be fulfilled with a mathematics, science, or elective course or with a range of qualifying career and technical education courses or dual enrollment courses at a local community college. Students would be required to receive a grade of C- or better to meet this additional requirement. Students who would otherwise be CSU-eligible but are unable to meet this requirement because of course limitations at their high school would be automatically provided an exemption during the initial implementation of the requirement. The CSU proposed and began efforts to boost awareness, communication, and collaboration with school districts and other interested parties regarding the proposed change.

STUDY GOALS AND RESEARCH QUESTIONS

With this study, the CSU is hoping to better understand the potential effects the proposed policy change could have had on California high school students' access to the CSU system, the associations between taking an additional quantitative reasoning course and students' success at the CSU, the potential differential effects of the policy change on student groups that are historically underrepresented at universities, and the implementation needs for the proposed change to be successful and equitable.[3] To meet these goals, this report explores answers to the following research questions:

3 The CSU specifically identified Black and Latinx students and students from families with low incomes. The study further explores the potential effects on female and male students, English learners, first-generation college students, and students from rural areas and small towns.

TABLE 1

Current California State University (CSU) College Preparatory Coursework Requirements for First-Year Admission with Proposed Additional Quantitative Reasoning Requirement

COURSE REQUIREMENT AREA	SUBJECT	YEARS
A.	**History and Social Science** (including 1 year of U.S. history or 1 semester of U.S. history and 1 semester of civics or American government AND 1 year of social science)	2
B.	**English** (4 years of college preparatory English composition and literature)	4
C.	**Mathematics** (4 years recommended but only 3 years required at present including Algebra I, Geometry, Algebra II, or higher mathematics)	3
D.	**Laboratory Science** (including 1 biological science course and 1 physical science course)	2
E.	**Language other than English** (2 years of the same language; American Sign Language is applicable. A waiver of this requirement is possible if there is demonstrated competency in a language other than English.)	2
F.	**Visual and Performing Arts** (dance, drama or theater, music, or visual art)	1
G.	**College Preparatory Elective** (currently includes 1 year chosen from the University of California A-G list)	1
—	**Proposed Quantitative Reasoning Requirement:** Would add 1 additional year selected from “C – mathematics,” “D – laboratory science,” or a quantitative reasoning course from the “G – college preparatory elective” areas	(1)
Total required courses		15
Proposed total		(16)

NOTES: Adapted from the CSU website.

1. How might the proposed admissions policy change affect California high school students' access to the CSU?

2. How might the proposed admissions policy change influence students' success at the CSU?

3. Are there any potential differential effects the policy change may have on CSU access or success for different groups of students, including those groups historically underrepresented at universities?

4. What are the attitudes of district and high school staff, CSU staff, and students about the possible effects of the proposed policy change on CSU access and success?

5. Are there disparities across districts in their capacity to offer courses that meet the proposed admissions policy change? What concerns do district and high school staff have about implementation?

6. What resources did district and high school staff identify would need to be in place (implementation requirements) for this proposed change to be successful and equitable across schools and districts?

While the main purpose of this study is to support the CSU and the CSU Board of Trustees in their decision making on the proposed policy change, findings from this study may also be useful to other educational entities within California and in other states when considering high school graduation and college eligibility requirements that have implications across institutional lines. While the data is specific to California, the study provides insights around college access and success and educational equity using a very large and robust state data system with hundreds of thousands of students and detailed records across high school and college. It further includes qualitative research, which helps to capture local variations and perceptions that acknowledge and address needs in places where the policy could have different effects than what is seen on average across the state.

METHODS AND DATA SOURCES

As noted above, the study includes two types of research. Quantitative analyses were conducted using student- and school-level records collected from the CDE and the CSU system, and qualitative analyses were conducted using interview data collected across the state from people in a variety of roles in districts, high schools, and CSU campuses, as well as students. Table 2 maps each research question to the data sources used and analyses conducted to answer that question.

As shown in the table, the quantitative analyses were conducted using extensive student-level data from the CDE, including all available course data from eighth through twelfth grade for all California public high school graduates.[4] The analyses also include course and degree attainment data from the CSU system for all CSU enrollees. See Appendix A for a detailed description of the analyses conducted.

For the qualitative analysis, over 70 interviews and focus groups were conducted. Interviewees included staff members from school districts, high schools, CSU campuses, and the CDE, as well as high school and CSU students. The interviewees represented high schools and CSU schools from every geographic region of the state, and included districts with diverse populations of students by race/ethnicity, income, and locale (urban, suburban, and rural).[5] While the qualitative sample has good coverage of the state's diversity, it does skew in the direction of high schools identified as more likely to struggle with the proposed policy change, as those schools were purposely oversampled to better speak to potential implementation challenges.[6]

4 The data from the CDE includes student-level data submitted to the California Longitudinal Pupil Achievement Data System (CALPADS) by local education agencies referred to throughout this report as school districts.

5 See Appendix A for more information on the representativeness of the qualitative sample.

6 High schools identified as more likely to struggle with the proposed policy change include high schools

TABLE 2

Research Questions, Data Sources, and Analyses

RESEARCH QUESTIONS	DATA SOURCES	ANALYSES[a]
1. Potential effect of policy change on access to the California State University (CSU)	Student-level data from the California Department of Education (CDE) for all 2020 California public high school graduates[b]	Descriptive and correlational
2. Potential influence of policy change on college success at the CSU	Student-level data from the CDE and student-level data from CSU for all California public high school graduates who enrolled at CSU in fall 2015, fall 2018, and fall 2019[c]	Multivariate regression
3. Potential differential effects of policy change on college access and success	Student-level data from the CDE, student-level data from CSU, and school-level Common Core Data[d]	Descriptive, correlational, logistic regression, and multivariate regression
4. Attitudes about access, success, and equity	Interviews conducted from 2020 to 2022	Qualitative analysis
5. District capacity to implement the policy change	Interviews conducted from 2020 to 2022, and school-level course offering data from 2020	Qualitative analysis Descriptive analysis
6. Resources needed to implement the policy change	Interviews conducted from 2020 to 2022	Qualitative analysis

NOTES: [a]See Appendix A for more information on the analyses conducted.

[b]The study team ran the analyses for 2019 high school graduates as well and found similar findings as those for 2020 graduates. The study team decided to only report the findings from the most recent data available.

[c]Data from the 2018 and 2019 enrollees is used to measure outcomes during the first three semesters of college and data from 2015 enrollees is used to measure degree attainment at four, five, and six years after entering the CSU.

[d]Common Core Data were used to identify school location (urban, suburban, town, or rural).

The following sections discuss the findings under each of the six research questions. The final section discusses takeaways and considerations coming out of the findings.

the CSU system identified as needing additional support if the policy change were to go into effect, high schools that do not offer any courses that would allow students to meet the additional requirement, high schools that had the worst ratio of senior student enrollment to quantitative reasoning courses offered, and high schools with the lowest percentage of graduates meeting A-G course requirements.

FINDINGS

CSU Access: Almost All Students Who Meet A-G Course Requirements Would Also Meet the Proposed Additional Requirement

The first research question helps to identify and quantify any barriers to CSU access created by the proposed policy change. To do this, the study team explored how this policy change may affect the broader population of all California public high school graduates as well as those graduates applying to and enrolling at the CSU.

Key Findings

- Most high school graduates, CSU applicants, and CSU enrollees who meet A-G course requirements also meet the proposed quantitative reasoning requirement.

- There are a considerable number of high school graduates who do not meet current A-G course requirements (40.3 percent), and over two-thirds of these students do not meet the mathematics or science requirement specifically. However, the vast majority of CSU applicants (92.7 percent) and enrollees (95.6 percent) meet A-G course requirements.

As shown in Table 3, most 2020 high school graduates across California (59.7 percent) and almost all CSU applicants (92.7 percent) and CSU enrollees (95.6 percent) met A-G course requirements, according to analyses of CDE records. Still, there are a substantial number of high school graduates who did not meet A-G course requirements (40.3 percent) and many of these students did not meet the requirements because they failed to successfully complete one of the mathematics or science course requirements with a grade of C- or better (27.8 percent). For this group of students who are already failing to meet the current A-G mathematics and science requirements and so are generally not eligible to attend CSU directly out of high school, the proposed additional requirement would create another barrier to their eligibility and add more distance between their course-taking and the course-taking of their CSU-bound counterparts. One consideration for school districts may be whether a move in the CSU eligibility requirements might constitute a need for a change to high school graduation requirements to ensure parallel trajectories for students who intend to go to a university and those with other postsecondary plans, including community college where meeting A-G is not required.[7]

7 While current state high school graduation requirements only include two mathematics and two science courses, there are a growing number of school districts across the state that require more mathematics and science courses in order to graduate. These districts meet and often exceed the current A-G requirements for mathematics and science. See Gao (2021) for more information on high school graduation requirements across the state.

TABLE 3

Percentage of Students Meeting Current A-G Course Requirements, 2020 Graduates

COURSE REQUIREMENTS	ALL HIGH SCHOOL GRADUATES	CSU APPLICANTS	CSU ENROLLEES
Met A-G course requirements	59.7	92.7	95.6
Did not meet A-G course requirements	40.3	7.3	4.4
Missing mathematics or science unit (C or D requirement)	27.8	2.6	1.2
Missing unit(s) other than mathematics or science (A, B, E, F, or G)	12.5	4.7	3.2

SOURCE: Data provided by the California Department of Education.

NOTES: There are 382,475 high school graduates, 136,713 California State University (CSU) applicants, and 50,128 CSU enrollees included in this analysis. Note that 10 percent of high school graduates were not included in this analysis due to missing data.

For CSU applicants and enrollees, very few (7.3 percent and 4.4 percent, respectively) do not meet A-G requirements and even fewer do not meet A-G requirements because they were missing a mathematics or science course requirement.

Some readers may wonder how the study team assessed whether students met the A-G course requirements and how this matches the CSU process. The CSU system makes enrollment decisions based on a review of each individual student's transcripts. The study team used data submitted to the California Longitudinal Pupil Achievement Data System (CALPADS) by school districts and other local education agencies. In these data, the school districts report courses taken and grades received as well as a summative measure of whether graduates met A-G course requirements. While the study team used this summative measure in the meeting A-G analyses discussed above, some adjustments were made due to issues found in the data.[8] Just over 8 percent of 2020 high school graduates met A-G course requirements according to the study team's analysis of the course data but were marked as not meeting A-G requirements according to the summative indicator. For this study, these students are counted as meeting A-G course requirements. For this reason, the overall percent meeting A-G course requirements reported here is likely higher than what is reported in other places where the summative indicator was used.[9] Another potential difference between these findings and other reporting of met A-G course requirements is that approximately 10 percent of high school graduates were dropped from the analyses in

8 See page 20 of Fong, Barrat, and Finkelstein (2018) for details on potential mismatches in data between transcripts reviewed by CSU and course data from CALPADS.

9 Please see Appendix A for more information on how the study team calculated "met A-G course requirements" and "met the proposed additional requirement".

this report due to missing course data. All four years of high school course data were required to identify if students met A-G course requirements and the proposed additional requirement.[10]

Nearly all students who met A-G course requirements (93.8 percent) also took and passed (with a grade of C- or better) an additional quantitative reasoning course that would fulfill the proposed additional requirement even though this requirement is not yet in place. As shown in Table 4, of the high school graduates that met A-G requirements, only 6.2 percent (or approximately 15,000 students across the state) did not meet the proposed additional requirement. Even smaller percentages of CSU applicants (3.2 percent or about 4,000 students) and enrollees (3.2 percent or about 1,500 students) who met A-G requirements did not meet the proposed additional requirement.

TABLE 4

Percentage of Students Who Met A-G Requirements Also Meeting Proposed Quantitative Reasoning Requirement, 2020 Graduates

QUANTITATIVE REASONING REQUIREMENT	ALL HIGH SCHOOL GRADUATES	CSU APPLICANTS	CSU ENROLLEES
Met proposed quantitative reasoning requirement	93.8	96.8	96.8
Did not meet proposed quantitative reasoning requirement	6.2	3.2	3.2
Never attempted an additional course	1.7	0.9	0.9
Attempted but failed an additional course	4.5	2.4	2.3

SOURCE: Data provided by the California Department of Education.

NOTES: There are 228,273 high school graduates, 126,798 California State University (CSU) applicants, and 47,921 CSU enrollees that met A-G requirements and are included in this analysis. Note that 10 percent of high school graduates were not included in this analysis due to missing data. Rounding caused slight discrepancies in sums and differences.

The proposed additional requirement can be fulfilled in many ways. It includes many types of courses and does not require the course to be taken during senior year. Students met the requirement by taking an additional area C mathematics course, area D laboratory science course, or a quantitative reasoning-focused area G elective course. On average, high school students who met the proposed additional quantitative reasoning requirement took and passed 4.3 units of area C mathematics (while only 3 units were required to meet A-G) and 3.4 units of area D laboratory science (while only 2 units were required), as well as 0.3 units of quantitative reasoning-focused

10 Students that did not have all four years of data either did not attend a California public high school during all four years (i.e., they may have transferred to a private school or lived out of state for part of the four years) or there was some issue with their data (i.e., it was not provided by the school district or there was some issue with their ID and the data could not be properly matched over the four years). The study team compared the records of students included in the analysis to the records of the students dropped from the analysis and found that students dropped from the analysis were more likely to come from non-comprehensive high schools and charter districts and were slightly more likely to be Black or White, and less likely to be Latinx. Dropped records were no more likely to be from students flagged as qualifying for free/reduced priced lunch. Since the summative measure of “met A-G” is often missing in the dropped records, it is not clear if the dropped records were more or less likely to include students who meet A-G course requirements.

area G elective courses. Some of the most popular quantitative reasoning electives include Earth Science (a non-laboratory science course); classes in computer literacy, computer science, and computer programming; Consumer Mathematics (a mathematics course not included in area C); and Forensic Science (a non-laboratory science course). This suggests that most of these students tended to take and pass (with a grade of C- or better) an additional mathematics and an additional science course above and beyond what is currently required, and many also took and passed an additional quantitative reasoning elective course.

For the small percentage of all high school graduates who did not meet the proposed additional requirement, most attempted an additional mathematics or science course but did not pass the course with a C- or better (4.5 percent of the total students that met A-G requirements); fewer never attempted an additional quantitative reasoning course (1.7 percent). This suggests that most of the students not meeting the additional requirement were not hampered by their high school's capacity to offer a qualifying quantitative reasoning course, but rather failed to succeed in a course they took. While this could mean that these students were not well prepared for the course by their earlier classes, they did not have the supports they needed to succeed in the course, or they were not motivated to do well in the course, it suggests the school did offer a qualifying course.

CSU Success: Taking an Additional Quantitative Reasoning Course in High School is Associated with Better College Outcomes

This set of analyses seeks to determine whether, or to what extent, taking and passing an additional quantitative reasoning course might support students' success in college.

Key Findings

- While the proposed requirement may only affect the actions of a relatively small number of students who meet A-G course requirements but do not currently meet the proposed additional requirement, the findings suggest that taking and passing an additional course could help some of these students have better college outcomes. This remains true for students' ability to pass their first college-level mathematics course, even after accounting for some measures of students' high school mathematics performance and attendance.

- Further, there is a strong association between taking a quantitative reasoning course during senior year of high school and STEM degree attainment, even after accounting for students' high school performance and attendance. This suggests that taking and passing additional quantitative reasoning courses in high school may support students' decisions to pursue and their ability to succeed in STEM degrees.

To determine the potential effects on college success, the study team looked at students who graduated from California public high schools and enrolled at the CSU in 2018 or 2019 and compared the short-term college outcomes (successfully completing their first college mathematics course, persistence in college, and college credits earned) for students who did or did not take and pass (with a grade of C- or better) an additional quantitative reasoning course in high school.

Of 2018 and 2019 CSU enrollees, 95 percent completed an additional quantitative reasoning course during high school beyond the A-G requirements (similar to the 96.8 percent of enrollees that completed an additional course in 2020 shown in Table 4). As shown by the blue bars in Figure 1, these students were more likely to pass their first college mathematics class, were more likely to still be enrolled at the CSU into their second year, and attained a higher average number of college credits from the CSU than enrollees who did not take and pass (with a grade of C- or better) an additional mathematics or science course (see Appendix Table B.10 for more detail).[11]

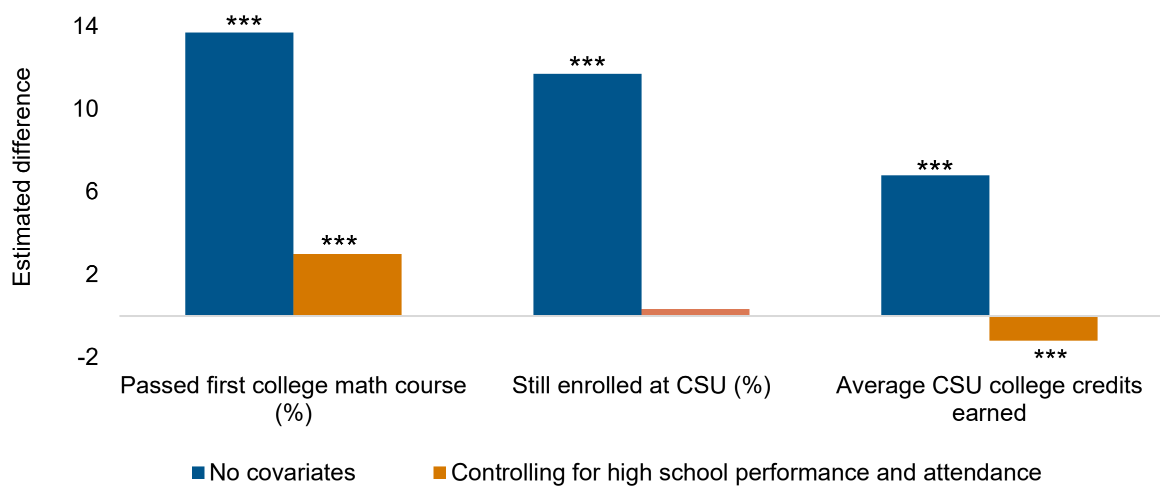
The study team hypothesized that students who perform well in mathematics and who attend high school regularly are more likely to take and pass an additional quantitative reasoning course and are also more likely to succeed in college than their counterparts who have lower performance or are chronically absent during high school. For this reason, these analyses were also conducted controlling for measures of students' high school performance in math, including whether students scored proficient or above in mathematics on the eleventh grade state standardized test and their high school grade point average in mathematics courses, as well as whether they were chronically absent.

After accounting for students' high school performance and attendance, students who took and passed an additional quantitative reasoning class during high school are still more likely to pass their first college mathematics course than their counterparts who did not (see the first orange bar in Figure 1). This suggests that regardless of students' performance and regular attendance in high school, taking an additional mathematics course in high school may support students' success in college math. After accounting for high school performance and attendance, completing an additional quantitative reasoning course is no longer associated with persisting during the first year and a half of college (there is no second orange bar because the difference is basically zero) or earning more college credits (see the third orange bar which shows a slight

11 As shown in Table 3, there are some students who enrolled in CSU who do not meet the A-G course requirements, according to the analysis of CDE records. Since these students were enrolled in CSU, it is assumed that they were eligible for enrollment at CSU, and they are included in this analysis. Students that did not meet one of the current A-G mathematics or science requirements (those requirements under areas C or D) are included with the students that did not meet the proposed additional quantitative reasoning requirement since they could not meet the proposed additional requirement without meeting the current requirement. There were 5,848 CSU enrollees in 2018 and 2019 who did not take and pass (with a grade of C- or better) an additional mathematics or science course in high school, which is 5.5 percent of the total population of CSU enrollees. Of these 5,848 students, 3,581 (or 61 percent) also did not complete all the required mathematics or science courses (areas C or D) to meet A-G requirements. We did a check of this analysis by removing the 3,581 students who did not meet one or more of the C or D requirements from the analysis and found somewhat smaller but generally similar effects (see Appendix Table B.11).

FIGURE 1

Estimated Differences in Short-Term College Outcomes Between California State University (CSU) Enrollees Who Did or Did Not Pass an Additional Quantitative Reasoning Course in High School, End of Third Semester, 2018 and 2019 Enrollees



SOURCE: Data provided by California Department of Education and CSU.

NOTES: The asterisks represent statistical significance at the 1 percent level, meaning that if the actual difference was 0, the probability of seeing the difference shown here would be no more than 1 percent. The sample includes 101,269 students who met the proposed requirement and 5,848 students who did not meet the proposed requirement (note that 3,581 of these students also did not meet either the science or mathematics A-G requirement). The first two metrics are based on the percentage of students while the third metric is on a different scale, the number of college credits earned.

negative difference).[12] This suggests that the difference in the blue bars for these outcomes are likely driven by the fact that students with better high school performance and attendance are more likely to take the additional course, and they are also more likely to succeed in college. Once high school performance and attendance were accounted for, taking the additional course is no longer positively correlated with these outcomes.

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12 The negative finding suggests that after controlling for high school performance and engagement, meeting the additional requirement is associated with attaining slightly fewer CSU college credits (-1.2 credits at the end of the third semester). The study team also looked at attempting CSU credits and found that meeting the additional requirement is also associated with attempting slightly fewer CSU college credits suggesting that this difference is more about students taking fewer courses than about students passing fewer courses they take. One potential reason for this could be that students that took an additional quantitative reasoning course in high school, especially those with higher mathematics performance, are also more likely to have taken dual enrollment or Advanced Placement courses in high school and so could be coming to their CSU campus with more college credits. Students starting college with more college credits may feel less need to take additional courses each semester than their counterparts starting with fewer college credits. It is also possible that students taking a quantitative reasoning course during senior year are more likely to major in a STEM field in college. Course-taking patterns may be somewhat different for students participating in STEM degrees compared to students in non-STEM degrees.

The study team further explored longer-term college outcomes including CSU degree attainment and STEM degree attainment. For these measures (which require looking at students who graduated high school and enrolled in CSU in 2015), the CDE does not have full high school course data going back before these students' senior year. Therefore, this analysis compares enrolled students who took and passed (with a grade of C- or better) a quantitative reasoning course in senior year of high school to those who did not take a quantitative reasoning course in senior year.

As seen in Figure 2, whether controlling for high school performance or not, students who took a quantitative reasoning class during senior year, were more likely to attain a degree and were much more likely to attain a STEM degree (see Appendix Table B.12 for more detail). These findings suggest that taking a quantitative reasoning course during senior year is associated with degree attainment and with STEM degree attainment regardless of students' high school performance and attendance.

Potential Differential Effects: No Evidence that the Proposed Additional Requirement Would Change Existing Disparities in Meeting A-G Course Requirements

Beyond understanding how the proposed policy change may affect students' access to and success at the CSU on average across all students, the CSU is also interested in whether any potential differential effects are possible especially for students historically underserved by universities. The study team ran similar analyses as discussed in the first two sections, looking at a variety of groupings of students (including groupings by race and ethnicity, socioeconomic status, gender, parent education level, school location, and English learner status) and comparing the differences in effects across these groups.

Key Findings

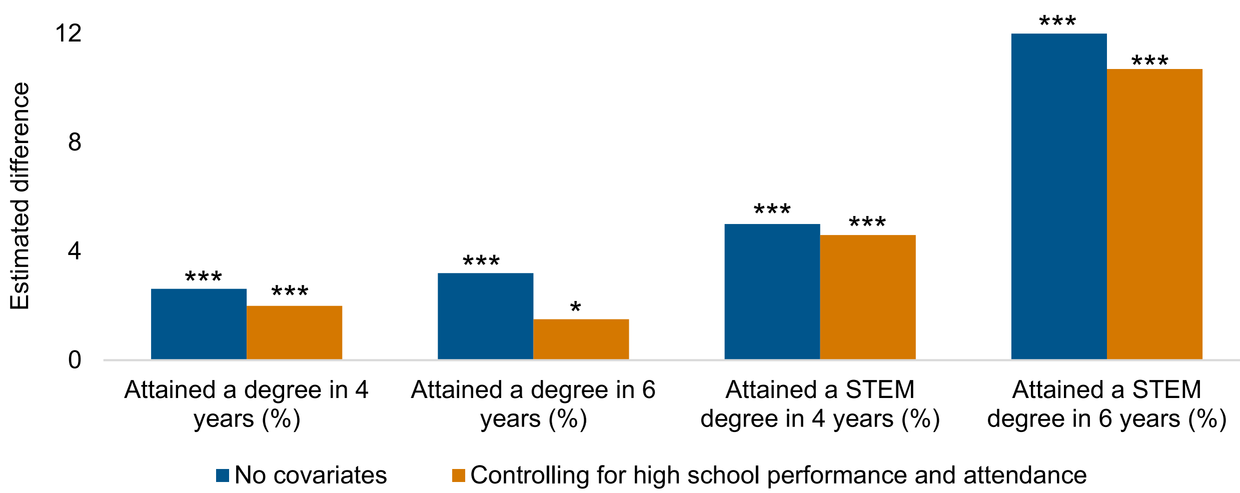
- Disparities in the percentage of students meeting the current A-G course requirements exist across almost all the subgroups explored, and the proposed additional requirement is unlikely to diminish or intensify these disparities. For the small group of students that did not meet the proposed additional quantitative reasoning requirement (6.2 percent of high school graduates), similar disparities were found across all groups as were found for those students who did not meet the current A-G course requirements.

- Disparities in college outcomes also exist between student groups but taking an additional quantitative reasoning class is associated with better college outcomes for most groups.

- In particular, taking a quantitative reasoning course during senior year of high school is associated with STEM degree attainment for all groups of students explored.

FIGURE 2

Estimated Differences in Long-Term College Outcomes Between California State University (CSU) Enrollees Who Did or Did Not Pass a Quantitative Reasoning Course During Senior Year of High School, 2015 Enrollees



SOURCE: Data provided by California Department of Education and CSU.

NOTES: The asterisks represent statistical significance (*** = 1 percent level and * = 10 percent level), meaning that if the actual difference was 0, the probability of seeing the difference shown here would be no more than 1 or 10 percent, respectively. The sample includes 45,717 students who took and passed a quantitative reasoning class during senior year and 3,580 students who did not take and pass a quantitative reasoning course during senior year.

College Access

For 2020 high school graduates, there are disparities in the percentages of students who met the A-G requirement across most of the student groups explored as shown by the light blue bars in Figure 3 (see Appendix Table B.1 for more details). That said, all student groups explored had relatively small percentages of students that met A-G course requirements but had not taken and passed (with a grade of C- or better) an additional quantitative reasoning course during high school as shown by the difference in size between the light blue and dark blue bars in Figure 3 (see Appendix Table B.4 for more detail).[13]

To further understand whether there are relationships between certain subgroups of students and whether students meet A-G requirements and/or meet the proposed additional requirement, the study team also ran logistic regressions to measure the associations between meeting A-G requirements and meeting the proposed additional quantitative reasoning requirement and each of the key demographic characteristics associated with each of the subgroups of students

13 Similar analyses were done looking at CSU applicants and enrollees and the findings for those descriptive analyses can be found in Appendix Tables B.2, B.3, B.5, and B.6.

shown in Figure 3. The study team ran these associations accounting for high school mathematics performance and attendance.[14]

As shown in the first column of Table 5, when controlling for performance and attendance, the logistic regression analysis suggests a similar story as in Figure 3 for most student groups. Male students, students from families with low incomes, students with parents who did not attend college, students who participated in an English learner program, and students who went to high school in a small town or rural area are all less likely than their counterparts to meet A-G course requirements. But, after accounting for high school performance and attendance, Latinx students are more likely than their White counterparts to meet A-G course requirements; Black students have a similar likelihood to meet A-G requirements as White students; and suburban students are less likely to meet A-G requirements than their urban counterparts.

As shown in the final column of Table 5, for those students that met A-G requirements, after accounting for mathematics performance and high school attendance, students eligible for free or reduced price lunch, students who participated in an English learner program and those from suburbs, small towns, or rural areas were less likely to have taken and passed an additional quantitative reasoning course that would fulfill the proposed requirement than their counterparts.[15]

College Success

The study team also looked at the short-term and long-term college outcomes for all the student groups discussed above, and further explored these outcomes accounting for high school mathematics performance and regular attendance. Across all groups of students explored, taking an additional quantitative reasoning course is associated with students passing their first college-level mathematics class (see Appendix Table B.13), persisting into their second year of college (see Appendix Table B.15), and earning more CSU college credits during the first three semesters (see Appendix Table B.17). Once high school performance and attendance are accounted for, there is still an association between students' passing their first college-level mathematics course and taking an additional quantitative reasoning course for most student groups except for rural and small-town students (see Appendix Table B.14). As with the full sample of students, there are no positive associations found between taking an additional quantitative reasoning course and persisting in college (see Appendix Table B.16) or earning more CSU credits (see Appendix Table B.18) for any of the groups of students.

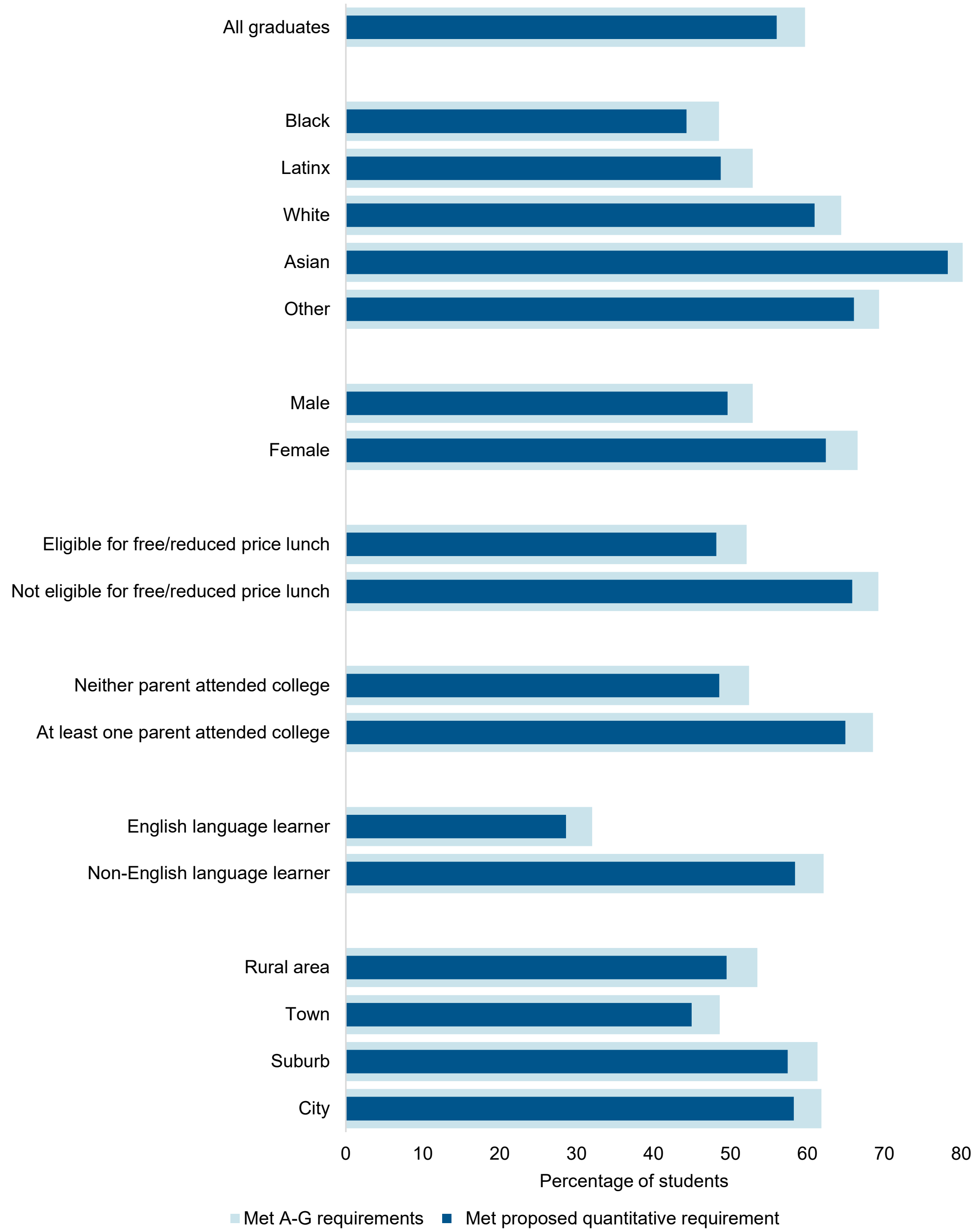
There were mixed results in the associations found between taking a quantitative reasoning course during senior year of high school and completing a CSU degree across the different groups of students (see Appendix Tables B.19 and B.20). While most of the associations are positive, there are two groups of students that stuck out as potentially lacking an association or having a negative association: Latinx students and students from rural communities. These findings

14 See Appendix Tables B.7 and B.8 for more detail including associations with and without controlling for high school performance and attendance and Table 9 for associations for CSU applicants.

15 Rural and small-town schools had somewhat fewer quantitative reasoning course offerings (an average of 25 and 24, respectively) than urban schools and suburban schools (an average of 31 and 33, respectively), according to an analysis of 2020 course offerings.

FIGURE 3

Percentage of 2020 High School Graduates Who Met A-G Course Requirements and Met Proposed Quantitative Reasoning Requirement, by Subgroup



SOURCE: Data provided by the California Department of Education and the California State University.

NOTES: There are 382,475 total high school graduates included in this analysis.
"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.
"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

TABLE 5

Associations Between Meeting A-G Requirements and Meeting the Proposed Requirement and Student Characteristics, Controlling for School Performance and Attendance, 2020 High School Graduates

STUDENT CHARACTERISTIC	MEETING A-G	MEETING THE PROPOSED REQUIREMENT
Black	NS	NS
Latinx	✓	NS
Female	✓	NS
Eligible for free/reduced price lunch	✘	✘
Parents have not attended college	✘	NS
English language learner	✘	✘
From a rural area[a]	✘	✘
From a town	✘	✘
From a suburb	✘	✘

SOURCE: Data provided by the California Department of Education.

NOTES: The ✓ denotes a positive association between the student characteristic and meeting A-G or meeting the proposed requirement. The ✘ denotes a negative association between the student characteristic and meeting A-G or meeting the proposed requirement. "NS" denotes that the association was not significant at the 0.1 percent level. There are 382,475 high school graduates included in the analysis in the first column and 228,273 students who met A-G requirements and the additional requirement included in the second column.

[a]Rural area, town, and suburb are designations for school location as defined in the National Center for Education Statistics' Common Core of Data.

suggest that taking a quantitative course during senior year may be less associated with CSU degree attainment for these two groups, but the findings are somewhat inconclusive.[16] Taking a quantitative reasoning course during senior year of high school is associated with STEM degree attainment within six years for all groups of students even when controlling for high school performance and attendance (see Appendix Tables B.21 and B.22).

Overall, these findings suggest that taking an additional quantitative reasoning course during high school may provide some benefit toward college success for all student groups.

16 As shown in Appendix Tables B.19 and B.20, these associations are negative but not statistically significant in either case (both with and without controlling for high school performance and attendance). The Latinx students are shown to be statistically different than their counterparts, while rural students are not.

Staff and Student Attitudes: Proposed Policy Change Has Potential to Improve College Success but Could Negatively Affect Equitable College Access

Prior to the completion of the quantitative analysis, the study team interviewed high school principals, teachers, and school counselors; school district administrators; CSU mathematics faculty, mathematics deans, and enrollment staff; CDE staff members; and high school and CSU students. They were asked to describe how they felt the proposed policy change may affect students' access to the CSU and their potential success at the CSU and what, if any, concerns they had about the proposed policy change causing any differential effects on student outcomes.

Key Findings

- Most respondents held mixed views of the proposed policy change. Most often, interviewees thought that the policy had the potential to improve college success but would almost certainly reduce college access.

- Nearly all respondents thought that this policy had the potential to improve students' ability to pass college mathematics courses. This was true across all roles in high schools and colleges, as well as for students. CSU mathematics faculty tended to be the most positive toward the change, though these staff members, like other respondents, saw the potential tradeoff with college access.

- Many staff members—especially high school staff—worried that some students who might have been able to succeed at the CSU might no longer be able to get in if the policy were put into place, and that the students most likely to be affected would be students of color and students from rural and high-poverty districts. Staff members from rural districts, high-poverty districts, and districts serving primarily students of color expressed great concern about the policy impacting their students.

Across the respondents interviewed, there was a mix of views about the potential effects of the proposed policy change. Notably, several respondents expressed that they thought the policy might have both positive and negative effects on students. Even staff who were not familiar with the proposed policy change prior to their participation in the interview were able to assess it in a nuanced way and see both pros and cons to the proposed change. For example, some high school mathematics teachers thought that the policy would simultaneously help students already on a college-bound track and leave behind some students who would otherwise be admitted to a CSU based on existing standards.

College access was top of mind for many respondents, especially in the high school domain. Nearly equal numbers of interviews produced positive and negative views of the policy's impact on college access. On the positive side, many CSU faculty and some high school mathematics teachers thought the policy change would prompt schools to offer, and students to take, a full four years of high school math, which would help them stay on a college-bound track and mindset during senior year. On the negative side, some high school and district staff members worried that many students would become ineligible for CSU admission due to this policy change.

Nearly all respondents thought that the proposed policy had the potential to improve college success in math, namely passing college mathematics courses. Most interviewed staff at both the high school and college levels identified mathematics proficiency as a serious barrier to students' college success and were hopeful that adding a quantitative reasoning course, that many students may choose to take in senior year, would keep up students' skillset upon entering college mathematics courses. CSU staff members in particular thought that the change would be highly beneficial: many mathematics faculty identified, in the words of one interviewee, "too much time since last mathematics course" as a risk factor they see in their first-year mathematics courses. As another interviewee explained, "If you take a year-long gap of mathematics, it slams you in the face when you arrive on a college campus."

As noted above, some high school staff members expressed skepticism that the improvements in college success in mathematics courses would be worth the cost of college access, and many high school staff members (from high schools with varied student populations) worried that the students most likely to be affected would be students of color. In particular, high school staff members were concerned that some high schools, especially rural schools and schools with large numbers of students from lower-income neighborhoods (which also often tend to have larger populations of students of color) are already facing mathematics and science teacher shortages and would struggle to provide the additional courses needed.

For districts that described themselves as serving a high-poverty population, the policy change proposal was met with great skepticism. One district administrator said, "It's going to limit a number of kids from entrance to CSUs… Our district is composed of… 90 percent socioeconomic [disadvantaged] students, and we do our best to get kids to that minimum requirement. And to add an additional course, my initial response is that it's going to limit that bottom percentage of students that are just barely making it." A principal in a different district leading a high school with similar demographics was blunter: "It's going to cripple the ability of my Hispanic students to qualify for college."

An important finding here is the *perception* of the magnitude of the proposed policy impact. Staff members from high schools, school districts, and CSU campuses thought that a great number of high schools—and therefore students—would be affected by the proposed policy change. This perception is not substantiated by the quantitative data, which suggests that the policy change would affect a relatively small number of students. This discrepancy may be because high school and district staff members are thinking about their students broadly, not just those already meeting A-G requirements, but those that may struggle to meet the current requirements. It is also possible that high school principals, teachers, and counselors were not able to gage off-hand how many students might already be taking one of the variety of courses that would meet the requirement (including mathematics, science, or quantitative reasoning-based electives). They may have focused mostly on senior year mathematics course-taking although students could fulfill the requirement in a variety of ways. It is also true, as noted earlier, that the study team focused on recruiting staff members from schools that would likely be disproportionately affected by the policy change and so many of the high school staff members may have been considering their local school, which could see a higher number of students not meeting the proposed additional requirement (differences across districts are discussed in the next section). As noted above, most interviews were conducted prior to the quantitative data analyses. Following completion of the quantitative study, a handful of interviewees were reconvened, and the findings were shared with them. Their opinions were not substantially swayed by the findings.

Some current CSU students expressed concerns about their own ability to meet the proposed requirement if it had been in place when they were applying to their CSU campus. Many students noted that they struggled in mathematics during high school and would have been hesitant to enroll in an additional or higher-level mathematics course. As one current CSU student explained, "I think if that was a policy that had been implemented while I was in high school and I was trying to get into CSU, I'm not really sure if I would be able to make that requirement because I just had a really hard time in high school with math… I would definitely be very stressed." But, when told of the variety of courses that would meet the requirement, many students responded favorably to the idea of offering more quantitative reasoning courses with real-world applications, such as computer science and financial literacy. They thought more relevant uses of mathematics would help them both in high school and in college.

Similarly, several high school staff members hoped that the addition of relevant, contextualized mathematics courses could help improve students' attitudes toward mathematics and perhaps even make them more likely to consider STEM fields. As one high school teacher said, "Students have been introduced to mathematics and have a perception of mathematics that is quite negative… the power of being able to use a mathematical lens to see the world is of value for all students, and all students should have that power presented to them, not just some students. And I think that this policy would make it so that the adults in the room would see it as their obligation to make sure students had that access. So, I think it's a good thing."

District Capacity: School and District Staff Members Expressed Concern About Capacity to Offer Additional Courses

The fifth research question explores the capacity of high schools and school districts to implement any changes needed to ensure high school students across the state could meet the proposed additional requirement. To answer this question, the study team analyzed school- and district-level data to better understand the extent of change needed and talked to school and district staff members across the state about potential capacity issues.

Key Findings

- Almost all regular public high schools offer at least one course that would meet the proposed requirement, but the variety of course offerings differs across high schools, and it is not known if districts could provide enough sections of these courses to support all interested students if the proposed change were to go into effect.

- While most districts have a relatively small percentage of students who meet A-G requirements not already meeting the proposed additional requirement, there are some districts that do have larger percentages of students that do not meet the additional requirement. About 25 percent of districts across the state have more than 10 percent of their students who meet

A-G requirements not currently meeting the additional requirement and about 4 percent of districts have more than 25 percent of these students. These districts may face larger hurdles and need more support to ensure their students can access the CSU if the proposed policy change were to be enacted.

- Many high school and district staff members interviewed expressed concerns about the ability of their schools to offer the additional courses needed for students to meet the proposed requirement. Their biggest concern was around the ability to find additional teachers with the proper credentialing to meet the increased course demand.

To better understand school district and high school capacity to implement this policy change successfully and equitably, the study team analyzed school-level data on courses provided across California high schools. Of the 1,487 schools identified as comprehensive schools with grades 9-12 or K-12, 98 percent offer at least one additional quantitative reasoning course beyond those required to meet the current A-G course requirements.[17] While this is good news, since the data only provide a list of course offerings, it is not clear how many course sections are offered in any given semester or year and whether that would meet the additional need caused by the proposed policy change.

Beyond just providing one course that would fulfill the proposed requirement, it might also be important for schools to provide a range of courses that support different interests and skill levels to fit the needs of a variety of students. The range of course options across the high schools is vast with schools offering anywhere from one course to over 100 potential courses that would meet the proposed requirement.[18] The mean number of courses offered is 30.5 and the median is 27, suggesting that many schools have a considerable variety of quantitative reasoning courses available.

While on average there is only a small percentage of students across the state who meet A-G requirements but do not meet the additional requirement, it is still possible that certain districts may face a much larger obstacle. As shown in Table 6, the study team found that 25 percent of districts have more than 10 percent of their graduates who meet A-G course requirements not already meeting the additional requirement, and 4 percent of those districts have over 25 percent of students not meeting the additional requirement. These districts may need additional support and planning to ensure their students are prepared to enroll in the CSU if the proposed policy were to go into effect.

17 Schools dropped from this analysis include those labeled as Adult Education Centers, Alternative High Schools of Choice, Continuation High Schools, District Community Day Schools, Juvenile Court Schools, Opportunity Schools, Other, Other Programs, and Special Education Schools.

18 Note that some of these courses may be online courses and/or dual enrollment courses offered by the local community college. They are not necessarily all offered every year.

TABLE 6

Number and Percentage of Districts by the Percentage of Students Who Met A-G Requirements but Did Not Meet the Proposed Additional Requirement

RANGE OF STUDENTS WHO MET A-G BUT DID NOT MEET PROPOSED REQUIREMENT (%)	NUMBER OF DISTRICTS	PERCENTAGE OF TOTAL DISTRICTS	NUMBER OF HIGH SCHOOL GRADUATES MEETING A-G
0-5	224	48	99,883
>5-10	128	27	83,378
>10-25	96	21	40,031
>25	20	4	1,508

SOURCE: Student-level data provided by the California Department of Education aggregated up to the district.

NOTES: This includes 468 districts that had at least 1 comprehensive school with grades 9-12 or K-12 in 2020. These districts range from having 1 to 20,142 graduates that met A-G course requirements. Note that 116 districts had fewer than 50 students that met A-G course requirements.

To complement the quantitative analysis, the study team interviewed high school and district staff members about their institutions' readiness to respond to the new policy if passed.[19] Many staff, especially principals, expressed concerns about the ability of their schools to offer the additional courses needed for students to meet the proposed requirement. Their biggest concern was around the ability to find additional teachers with the proper credentialing to meet the increased demand for higher level quantitative reasoning courses. This was especially pronounced in high schools that already struggle to find credentialed mathematics and science teachers, especially rural and low-income schools. Some school and district staff also worried that because of the current teacher shortage that was exacerbated by the pandemic wave of teacher retirements, it would not be possible to staff all the courses needed.[20] Sufficient staffing was also a common concern for high school and district staff in districts using the Integrated Math curriculum: their teachers are trained to teach the aligned Integrated Math sequence, and they do not have enough teachers who are familiar with teaching other mathematics courses to support those students interested in meeting the proposed requirement by taking an additional mathematics course.[21]

19 As noted above, most of these staff members came from schools and districts the study team identified as being less likely to be able to meet the additional requirement. The roles included high school counselors, mathematics teachers, and principals, as well as district administrators in a variety of roles from curriculum coordinator to superintendent.

20 While many high school staff members were concerned about how the pandemic wave of teacher retirements would make it difficult to staff new courses, very few staff were concerned about pandemic-related learning loss impacting the policy. Staff were confident that the learning loss associated with the pandemic would be resolved by the time this policy were to go into place in 2027.

21 Some California school districts have moved in recent years to a new curriculum called Integrated Math that integrates mathematical fields like algebra, geometry, and statistics throughout the high school curricula and across grades. This replaces the traditional mathematics sequence of Algebra I, Geometry, and Algebra II offered in the ninth, tenth, and eleventh grades, respectively.

In most cases, district administrators thought that they would be able to support their local high schools with other resources like professional development and curricular support to add or expand courses that fit the proposed quantitative reasoning requirement. District administrators also thought they could assist high schools with information campaigns directed at students and parents to ensure that they know about the requirement far in advance, even back-mapping courses to students' freshmen years to ensure they can meet the new requirement. They were not confident, however, about their ability to support high schools in finding the teachers to offer enough courses, given the shortage.

Finally, several high school teachers flagged that districts need to figure out how early to start implementing the additional courses as well as what one mathematics teacher termed "vertical articulation" back to middle school, to ensure that there would be enough paths (especially within the Integrated Math curriculum) for students of different skill levels to fulfill the new requirement.

Resources Needed: Funding for Additional Teachers and Improved Coordination and Communication Across the State

The CSU tasked the study team with identifying implementation needs for the proposed change to be successful and equitable. To this end, the study team asked interview participants to describe the resources they thought would be needed to successfully implement the change.

Key Findings

- High school staff members most often identified state funding as their primary need. The funding would support recruiting and hiring additional teachers, providing professional development, and supporting credentialing of current or former teachers for the new courses.

- Beyond funding, district and high school staff members also noted a need for improved coordination and communication about the policy change and how to support students to meet the proposed new requirement.

As described previously, high school staff members' biggest concern was around the ability to find additional teachers with the proper credentialing to meet the increased demand for quantitative reasoning courses. High school staff members of all levels were concerned about the teacher pipeline for mathematics and science teachers and whether there would be enough available teachers to meet the potential additional need. Several high school teachers and principals wondered if teachers with other credentials would get funding to re-credential so that they could teach the quantitative reasoning courses and suggested this would be something that the state could fund to alleviate staffing issues.

Staff members also suggested that state funding would be needed for general professional development, including teaching school counselors about how to help students navigate the policy change, and to purchase new textbooks.

In addition to financial resources, respondents at both the high school and college levels thought that it would be vital to have improved coordination and communication around the specifics of meeting the policy, both vertically (from middle school to high school to college) and horizontally (district to district and district to CDE). One high school principal suggested including high school mathematics teachers or school counselors on panels with the CSU decision-makers developing the policy. Several district administrators and principals also raised the question of how this policy change would interact with the public perception that there are not enough spots in CSUs for qualified students and speculated that the public would wonder whether it was designed to limit entry.

Relatedly, an important finding from the interviews that is worth considering in the messaging and outcomes of this proposed policy change is a high level of uncertainty about the impacts of *past changes*. Most interviewees were aware of other changes that the CSU has made around placement testing and the use of corequisite courses instead of traditional college remediation in mathematics. However, none of the interviewees seemed to know the result of those policies: many asked whether those changes had helped students and how big of a problem mathematics under-preparation was following the changes. Notably, even many of the CSU mathematics faculty said they did not know whether the CSU had measured the impacts of those changes and, if so, what the findings were.[22] Interviewees were also curious whether this proposed policy change complemented the earlier policies.

Many high school staff members also thought that the burden of starting the conversation and paying for information campaigns aimed at parents and students needed to come from the CSU, not only from the high school districts. One CSU student agreed, saying, "Orientation team leaders or leaders from the CSU campuses [should] go to the high schools and talk about it… to talk about how useful it really is and to justify the reason behind it, maybe that would help future students." As one high school mathematics teacher explained, "If the university is saying, here's the new requirement, this is what we want it to be, then we want them to say, I'm here with you in this fight. But that requires money, that requires people to actually, you know, get their hands dirty."

CONCLUSION AND CONSIDERATIONS

The good news coming out of the quantitative research is that the vast majority of California high school graduates that may aspire to attend the CSU are already taking and passing an additional quantitative reasoning course even though it is not currently required. Almost 94 percent of all high school graduates and 96.8 percent of CSU applicants who met the current A-G requirements already took and passed an additional quantitative reasoning course. Several districts already require an additional course for high school graduation, and many students

22 Note that the CSU has done annual reports to its Board of Trustees on the results of these initiatives and has also commissioned several third-party studies of these initiatives. See Bracco, Barrat, Skjoldhorne, and Finkelstein (2021) and Bracco, Huang, Fong, and Finkelstein (2021) for recent examples.

across the state are taking coursework beyond the minimum requirement of their own volition and likely on recommendation from their counselors, teachers, family, and peers. To some extent, if the proposed policy change were to be implemented, it would align the actual minimum requirements to what seems to be the perceived standard most students interested in attending the CSU already attain.

The data suggest—and interview respondents across the state agreed—that for students who attend the CSU there is a likely benefit to taking an additional quantitative reasoning course during high school. Taking this type of course is positively associated with completing a first college-level mathematics course, earning a degree, and earning a STEM degree. That said, with so many CSU applicants and enrollees already meeting this requirement, a formal change in the policy may not have led to a widespread change in behavior, which could have limited the effect it would have on college success to a small number of students. Further, most students not meeting the proposed requirement are taking a qualifying course, but they are not passing the course. Requiring an additional course may not solve the problem without providing better preparation, quality of instruction, and/or support systems for these students.

The study also brings to light that there is a divergence happening in the quantitative reasoning course-taking and passing between those students meeting and not meeting A-G course requirements. While most students meeting A-G course requirements are taking and passing an additional quantitative reasoning course beyond those requirements, most students not meeting A-G requirements are missing at least one of the math or science course requirements, and often more than one (in some cases because they are not passing these courses with at least a C-).

If the goal is to ensure that more CSU students, and potentially more high school students in general, are taking more high-quality quantitative reasoning courses that explicitly prepare them for college and career success, it may make sense for the CSU system and its partners to focus on how to ensure those courses are provided with sufficient quality and quantity to all students and especially to those student groups that face disparities in college access. Many of the high school and school district staff members interviewed voiced concerns about equitable access to quality quantitative reasoning courses. Regardless of whether the CSU decides to pursue the change in their admissions requirements, it may be its partnerships with the CDE, school districts, and community colleges across the state that could have the most lasting effect on students' success at the CSU. These partnerships can support the building of strong preparatory courses and course pathways that are engaging and focused on the knowledge and skills most important to college and career success as well as efforts to build a stronger teacher pipeline to ensure there are qualified teachers to teach these courses.

Many of the interviewees who participated in the study highlighted supports that would help ensure more students have access to high-quality advanced quantitative reasoning courses: developing a broad coordination and communication effort across middle schools, high schools, districts, CSU campuses, community colleges, and the CDE; supporting the recruitment and hiring of qualified teachers; providing professional development to current teachers; and supporting current or former teachers with credentialling to teach higher-level math, science, or career and technical education courses with a quantitative reasoning focus. This study suggests that the biggest value added for students may not be in the formalization into policy of an elevated admissions standard that is already being attained by most applicants, but in the intentional collaboration between the K-12 and postsecondary educational institutions to authentically improve the preparation of students to ensure a more seamless transition into postsecondary education.

APPENDIX

A

Description of Research Methods

QUALITATIVE METHODS

The study team interviewed a set of stakeholders across the state, using a prespecified list of questions in an interview script, to collect information on participants' views of the proposed policy change and the resources they would need to implement it. Interviewees included high school principals, teachers, and school counselors; school district administrators; California State University (CSU) mathematics faculty, mathematics deans, and enrollment staff; two California Department of Education (CDE) staff members; as well as high school and CSU students. Sixty-seven total interviews and focus groups (with anywhere from two to six participants) were completed with the various staff members listed above. A total of 50 high school and CSU students were also interviewed.

Interview protocols for staff members included questions on the following topics: high school, school district, or CSU background (including students served, current mathematics requirements, student performance in mathematics, quantitative reasoning course offerings, tracking of college readiness, academic supports provided to students, and college mathematics placement); familiarity with the proposed policy change (policy change described if not familiar); perceptions of proposed policy change (including potential effect on college access and success, and who would be most affected by the change); high school and school district capacity to implement the policy change; and resources and supports needed to implement the policy change successfully.

Interview protocols for students included questions on the following topics: quantitative reasoning courses taken in high school and college, how the student made decisions on which courses to take during high school and college, experience in high school and college mathematics courses, familiarity with the proposed policy change (policy change described if not familiar), perceptions of the policy change (including potential effects on college access and success), supports students would need if the proposed policy change was put into place, and how best to inform students about the policy change.

Interviews were conducted between spring 2021 and winter 2022 prior to the quantitative analyses conducted by MDRC so the study team did not share quantitative findings with most interviewees. Once the quantitative analysis was finished in July 2022, the study team invited high school and school district staff members to additional focus groups to discuss the quantitative findings. A total of eight participants (with a variety of the roles discussed above) attended these focus groups.

The interviewees represent high schools and CSUs in every geographic region of the state; high schools in majority low-, middle-, and high-income communities; high schools with majority Latinx student populations; high schools with significant populations of Black students; high schools serving large immigrant family populations; one high school serving a sizable Native American student population as a percentage of its enrollment; and districts in urban, suburban, and rural areas. While the sample has good coverage of the state's diversity, it does skew in the direction of high schools identified as likely to struggle with the proposed policy change, as those schools were purposely oversampled to better learn about the barriers to success and identify the resources needed to implement the proposed change.

To oversample these schools, the study team constructed a sample of high schools identified as more likely to struggle with the proposed policy change. To do this, the study team created lists of (1) high schools the CSU identified as likely to need additional support if the policy change were to go into effect, (2) schools that do not offer any courses that would allow students to meet the proposed additional requirement (using data supplied by the CSU on courses offered by public high schools across the state), (3) high schools that had the worst ratio of senior student enrollment to quantitative reasoning courses offered (using both the high school course data provided by the CSU and publicly available data from the CDE on school enrollment), and (4) schools with the lowest percentage of high school graduates meeting A-G course requirements (from publicly available data from the CDE). After removing most of the charter schools to focus on regular public high schools, the study team randomly sampled from these lists.

Also included in the sample were a few schools in districts that already require students to meet the proposed requirement to graduate high school. These schools were included to provide information about the extent of the planning, effort, and resources needed to pull off the change.

To maximize the representativeness of the sample, the study team then created a list of California's geographic areas and key student demographics of interest. When these areas were not represented in the sample of schools and districts discussed above, additional schools and districts were added to ensure geographic and demographic representativeness.

To maximize respondents, snowball sampling was also used to get participants to suggest other potential participants for outreach. Snowball sampling is a research technique in which study participants are asked to identify and invite others they know to participate. For example, when a study team member spoke with teachers, they would ask them to share contact information and Internal Review Board-approved recruitment materials with other teachers they know who might be interested in participating. This technique was particularly helpful in recruiting high school staff members.

While the study team was ultimately able to meet the participation goals for district, high school, CSU, and CDE staff members, it was very difficult to get responses from students and parents (an initial goal of the study was to include both student and parent voices). This may be, in part, because the study team reached out to high school seniors and their parents and to CSU freshmen and sophomores, and none of these groups would be directly affected by the proposed policy change (since it was proposed to go into effect with the graduating class of 2027, which would include students too young and far removed from the college application process to interview). It may also have been timing, as during the time of outreach, students and parents had many competing demands on their time and interviews and focus groups were conducted via Zoom during a time of peak Zoom fatigue. Parent recruitment was particularly hard because the only means the study team had for contacting parents was through high school teachers sending home notices and asking students to invite their parents.

The study team decided to focus their efforts on increasing student outreach and discontinued parent outreach. In order to reach more students, the study team extended the outreach to students at all CSU campuses across the state and received outreach support from a number of these campuses. Following this redoubling of the student recruitment effort, the study team was able to speak to 50 students (the original goal was to interview approximately 100 students and parents). Only two parents were interviewed, and the data from those interviews were not included in the analyses. While the number of student respondents is more limited than intended, the participating students represent many types of high schools and CSU campuses across California.

Once the interviews and focus groups were complete, the study team used qualitative analysis software to code transcripts against a prespecified codebook of topics. All coders were trained together, simultaneously, on the codebook using a sample coding transcript to improve inter-rater reliability. The qualitative codes were used to generate summaries across all transcripts for specific topics and areas of interest. These summaries were then collated and analyzed to produce the findings presented in this memo.

QUANTITATIVE RESEARCH METHODS

Data Collected

To answer the first three research questions, the study team collected data from the CDE and the CSU system. The data from the CDE includes student-level data submitted to the California Longitudinal Pupil Achievement Data System (CALPADS) by local education agencies, referred to throughout the report as school districts. The data include all course data from eighth through twelfth grades as well as demographic, attendance, standardized state test data, and graduation information. The data collected include high school data for all 2019 and 2020 graduates of public high schools in California as well as high school data for fall 2015 and fall 2018 enrollees of the CSU who attended a public high school in California.[1]

The data collected from the CSU include lists of the 2018 enrollees, and 2019 and 2020 CSU applicants and enrollees, which were matched to the CDE data to create the CSU applicant and CSU enrollee subgroups. Data from the CSU also include course data for all enrollees who attended a public high school in California and enrolled in the CSU in either fall 2018 or fall 2019. The data also include CSU degree attainment data four, five, and six years after enrollment for all 2015 enrollees who attended a public high school in California.

To help understand district capacity (the fifth research question) data on the courses offered by public high schools across the state were provided by the CSU and used to identify the number of quantitative reasoning courses schools currently offer that would meet the proposed additional requirement.

How Students That Met A-G Requirements and Met the Proposed Requirement Were Identified

The study team used CALPADS data to calculate "Met A-G course requirements" across all high school graduates. In the CALPADS data, the school districts report courses taken and grades received as well as a summative measure of whether graduates met A-G course requirements. While the study team used this summative measure, some adjustments were made due to issues found with that measure.

The course-level data were first cleaned to remove erroneous course grade and credit values. Next, courses were categorized according to whether they could fulfill one of the A-G section requirements based on a mapping of CDE state course codes provided by the CSU. Once course categories were created, course data were aggregated to the student level. Students without data for all four years of high school (grades 9-12) were removed (approximately 10 percent of 2020 high school graduates). These

1 Note that for 2015 enrollees, full course data are not available in grades prior to students' junior and Senior years (2013-2014 and 2014-2015 school years).

students were removed because it was not possible to identify if students met A-G requirements or the proposed additional requirement, without students' full high school data. Note that most A-G courses are taken in high school, but Algebra I (the first course in the mathematics sequence) can be taken in eighth grade. Students missing eighth grade data were included as the study team was still able to identify if students took all the required mathematics courses even if they took Algebra in eighth grade and eighth grade data were missing (see below for an explanation of how this was done).

Students were then categorized as meeting or not meeting each of the A-G course requirements separately by adding up the courses taken and passed that met each category's requirement. To meet each of the A-G requirements, the student needed to pass all courses within the requirement with a minimum of a C- or a CR (which stands for credit in courses that are graded as credit or no credit). For category C (mathematics), end-of-sequence courses were also flagged (Algebra II, Intermediate Algebra, Integrated Math III). If a student passed an end-of-sequence course, they were marked as meeting C requirements even if the full sequence of courses required was not found in the data. This was possible since students are required to take the courses in a specific order. It helped the study team to better identify students that met the C category even if some course data or eighth grade data were missing. Similarly, if a student had only two earned section C courses including the end-of-sequence or higher courses but was missing eighth grade data, the student was marked as meeting the C requirements.

Students who met the minimum requirements for each of the A-G sections were flagged as Met A-G. This calculation of Met A-G was compared to the summative measure of Met A-G provided by school districts in the CALPADS data. About 8 percent of 2020 high school graduates met A-G course requirements according to the study team's analysis of the course data but were marked as not meeting A-G requirements according to the summative indicator. For this study, these students are counted as meeting A-G course requirements.

The study team also found that some students marked as meeting A-G course requirements by the school districts, did not meet the requirements according to the study team's course data analysis (13 percent of the 2020 high school graduates). Since some missing course data was likely, if a student was marked as meeting A-G course requirements by the local school district, that student was also marked as meeting A-G for study purposes even if the analysis of the course data did not find that the student met all the A-G course requirements. In most of these cases (82 percent), students were only missing one course usually in English, foreign language, history and social sciences, or visual or performing arts. The study team decided that these cases were more likely due to issues with the course data rather than issues with the indicator provided by school districts and included these students as meeting A-G course requirements for the purposes of this report.

Students who met the proposed quantitative requirement were identified among students meeting A-G course requirements by flagging students who took an additional quantitative course in sections C (mathematics), D (science), or G (elective). For section G in particular, quantitative courses were selected on the basis of course codes, as above.

Sample

There were 422,971 California public high school graduates in 2020 in CALPADS. Almost 10 percent of these students (40,496 students) were dropped from the analysis because they did not have data for all four years of high school. The analysis sample includes 382,475 high school graduates.

In order to measure how many applicants and enrollees met A-G and met the proposed additional requirement, the study team matched lists of these students from the CSU to the high school data set. For CSU applicants and enrollees, a list of 143,355 fall 2020 CSU applicants and enrollees was provided by the CSU. Applicants and enrollees were matched to 2020 and 2019 high school graduates. Five percent of the CSU applicants (6,642 students) were dropped from this analysis because a match was not found in the 2019 or 2020 high school data. Enrollees are a subset of applicants and the list included 52,186 CSU enrollees in 2020. Four percent of these enrollees (2,058 students) were dropped from this analysis because a match was not found in the high school data. Lack of matching data for applicants and enrollees may be due in part to the study team dropping students in the high school data set because four years of high school data were not provided (see discussion in the above section). It is also possible that a small set of these students graduated high school prior to 2019.

In order to measure the short- and long-term college outcomes of CSU enrollees based on whether they met the proposed additional requirement, the study team combined data from the CSU with the high school data. For the 2018 and 2019 enrollees, a list of 113,274 enrollees was provided by the CSU and matched to the 2018 and 2019 high school data, and 6,157 students (or 5 percent) were dropped because a match was not found. For the 2015 cohort of CSU enrollees, a list of 52,291 enrollees was provided by the CSU. Of these students, 6 percent (2,994 students) were dropped from the analysis because a match was not found in the high school data.

Analyses

College Access: For each of the groups of students included in the analyses focused on CSU access (all California public high school graduates, all CSU applicants, all CSU-enrolled students), the study team looked at frequency distributions for whether or not these students met the A-G course requirements and the proposed additional quantitative reasoning requirement across each of the sets of demographic subgroups: race/ethnicity, income level (measured using an indicator of receipt of free and reduced price lunch), gender, English proficiency, parent education level, and location (urbanicity) and the high school mathematics performance and high school attendance subgroups (whether the student met proficiency on the eleventh grade Smarter Balanced state standardized test, whether the student had a high school grade point average (GPA) in mathematics at 3.0 or above, and whether or not the student was chronically absent). Chi-square tests were used to measure the statistical significance of the differences between subgroups. These analyses are shown in Appendix Tables B.1-B.6.

To further discern the associations between the student characteristics and meeting the A-G course requirements or the proposed additional requirement, separate logistic regression analyses were run for each group of students including all demographic characteristics to see which factors predict whether students are more likely to successfully complete the A-G requirements or the proposed additional requirement. For these analyses, on the left-hand side of the model is the indicator of whether the student has met the A-G course requirements or the proposed additional requirement and on the righthand side of the model are the indicators for the demographic characteristics. This analysis uses the following regression model:

$$logit(MetStandard_{i)} = \alpha + \sum_{n=1}^{n=N} \beta_n X_{ni} + \varepsilon_i$$

Where

$\mathrm{MetStandard_i}$ = 1 if student i has met the A-G requirements or the proposed additional quantitative reasoning standard and 0 if not;

$\mathrm{X_{ni}}$ = the nth student characteristic for student i.

ε_i = error term

These analyses were run without any covariates and including the high school performance and engagement characteristics discussed above. These analyses are shown in Appendix Tables B.7-B.9.

College Success: For the college success analyses, a simple regression was used where the left side of the regression is the college outcome of interest (success in their first college-level mathematics course, persistence in college, college credits earned, degree attainment, and science, technology, engineering, or mathematics (STEM) degree attainment) and the right side of the regression model includes an indicator of whether or not the student met the proposed additional quantitative reasoning requirement (or for the long-term college outcomes, whether the student took a quantitative reasoning course in high school) and, for the subgroup analyses, interactions between that indicator and each of the demographic subgroup indicators (note that English learner status was not available for the earlier cohorts of students used in the college success analyses and is not included). This analysis was done separately for each of the outcome measures and each of the sets of subgroups. This analysis uses the following regression model:

$$Y_i = a + \beta_1 MetStandard_i + \beta_2 MetStandard_i * Subgroup_i + \varepsilon_i$$

Where

Y_i = college outcome for student i (success in their first college-level mathematics course, persistence in college, college credits earned, degree attainment, and STEM degree attainment);

$MetStandard_i$ = 1 if student i met the proposed quantitative reasoning requirement, and 0 otherwise;

$Subgroup_i$ = 1 if student i belongs to a given subgroup, and 0 otherwise; and

ε_i = error term

While comparing college outcomes of CSU students with and without an additional year of quantitative reasoning is helpful in understanding how this additional coursework may support students, there are many underlying factors that could influence the differences in success for these two groups. For instance, students' mathematics aptitude might influence their college outcomes as well as whether they meet the additional requirement. Therefore, the study team also ran analyses including each of the demographic subgroups separately but controlling for high school mathematics performance (whether student met proficiency on their eleventh grade mathematics state standardized test and high school GPA in math) and high school attendance (whether the student was chronically absent).

The full group analyses are shown in Appendix Tables B.10-B.12. The analyses including the demographic subgroups of students as defined above are included in Appendix Tables B.13-B.22.

APPENDIX

B

Supplemental Tables

The following are tables from the quantitative analyses that supplement the tables and figures included in the report. These tables provide the full analyses conducted on access to and success in the California State University (CSU) system.

The first nine tables represent the analyses conducted on college access. The first three tables look at the percentages of students that met the A-G course requirements for all public high school graduates (Table B.1), CSU applicants (Table B.2), and CSU enrollees (Table B.3). The next three tables look at percentages of students that took at least one additional quantitative reasoning course that would fulfill the proposed additional requirement for all graduates who met A-G requirements (Table B.4), CSU applicants who met A-G requirements (Table B.5), and for CSU enrollees who met A-G requirements (Table B.6). These tables all include data for 2020 high school graduates, CSU applicants, or CSU enrollees. Since the COVID-19 pandemic could have disrupted students' graduation from high school and entrance into college starting in 2020, a separate test was done to look at the same findings for 2019 high school graduates, CSU applicants, and CSU enrollees and similar results were found for this group of students. The most recent cohort (2020) is reported.

The final three tables look at associations between meeting A-G course requirements or meeting the proposed additional requirement and student characteristics to see which factors predict whether students are more likely to meet A-G requirements or meet the proposed requirement. Table B.7 shows the associations between meeting the A-G course requirements and student characteristics for all high school graduates. Table B.8 shows the associations between meeting the proposed additional requirement and student characteristics for all high school graduates that met the A-G course requirements. Table B.9 shows the associations between meeting the proposed additional requirement and student characteristics for CSU applicants who met A-G course requirements.

Tables B.10-B.22 represent the analyses conducted on college success. Table B.10 shows the difference in short-term college outcomes by whether CSU enrollees met the proposed additional requirement in high school. Note that included in the enrollees that did not meet the proposed additional requirement are those students who also did not meet the A-G course requirements. As a sensitivity test of Table B.10, Table B.11 shows the same short-term outcomes but only includes enrollees who met current mathematics (C) and science (D) A-G course requirements. Table B.12 shows the difference in long-term college outcomes by whether CSU enrollees took a quantitative reasoning course during senior year. The final tables (Tables 13-22) show these same analyses broken down by subgroup. Tables B.13 and B.14 look at the associations between meeting the proposed additional requirement and success in first college-level mathematics course for all demographic subgroups of students. Table B.13 does not include the high school performance and attendance covariates, and Table B.14 controls for high school performance and attendance. Similarly, Tables B.15 and B.16 look at the associations between meeting the proposed additional requirement and persisting at CSU. Tables B.17 and B.18 look at the associations between meeting the proposed additional requirement and CSU college credits earned. Tables B.19 and B.20 look at the associations between taking a quantitative reasoning course during senior year of high school and CSU degree attainment. Tables B.21 and B.22 look at the associations between taking a quantitative reasoning course during senior year of high school and attaining a science, technology, engineering, or mathematics (STEM) degree from CSU.

APPENDIX TABLE B.1

Percentage of 2020 High School Graduates Who Did or Did Not Meet A-G Course Requirements

SUBGROUP (%)	MET A-G	DID NOT MEET A-G		MISSING MATH OR SCIENCE[a]	MISSING OTHER REQUIREMENT[b]	SAMPLE SIZE[c]
All graduates	59.7	40.3		27.8	12.5	382,475
Demographic						
Race and ethnicity						
Black	48.5	51.5	†††	37.0	14.5	18,619
Latinx	52.9	47.1	†††	33.3	13.8	208,739
White	64.4	35.6	†††	24.0	11.7	85,271
Asian[d]	80.4	19.6	†††	11.1	8.5	50,767
Other[e]	69.3	30.7	†††	20.2	10.5	19,079
Gender[f]						
Female	66.5	33.5	†††	22.8	10.8	191,855
Male	52.9	47.1	†††	32.9	14.2	190,595
Socioeconomic status						
Eligible for free/reduced lunch	52.1	47.9	†††	33.6	14.3	212,866
Not eligible	69.2	30.8	†††	20.5	10.3	169,609
Parent education level						
Neither parent attended college	52.4	47.6	†††	33.6	14.0	164,065
At least one parent attended college	68.5	31.5	†††	20.9	10.6	195,800
English proficiency						
English learner	32.0	68.0	†††	49.6	18.4	30,891
Non-English learner	62.1	37.9	†††	25.9	12.0	351,584
School location						
City	61.8	38.2	†††	25.9	12.3	161,046
Suburb	61.3	38.7	†††	26.5	12.2	169,480
Town	48.6	51.4	†††	38.3	13.1	18,871
Rural area	53.5	46.5	†††	32.3	14.2	22,231
High school performance and attendance						
Math proficiency[g]						
Met proficiency	89.6	10.4	†††	3.3	7.0	129,126
Did not meet proficiency	45.8	54.2	†††	39.3	14.9	233,541

(continued)

APPENDIX TABLE B.1 (CONTINUED)

SUBGROUP (%)	MET A-G	DID NOT MEET A-G		MISSING MATH OR SCIENCE[a]	MISSING OTHER REQUIREMENT[b]	SAMPLE SIZE[c]
High school GPA in math						
3.0 or above	89.0	11.0	†††	4.4	6.6	118,105
Below 3.0	46.8	53.2	†††	37.9	15.2	262,902
High school attendance						
Chronically absent	33.7	66.3	†††	48.9	17.4	46,875
Not chronically absent	63.4	36.6	†††	24.8	11.8	335,248

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data.

NOTES: A chi square test was applied to the estimated difference between meeting A-G requirements and not meeting A-G requirements for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of the total students who missed at least one of the mathematics (C) or science (D) A-G course requirements.

[b]The percentage of the total students who did not meet A-G course requirements because they missed one or more courses other than mathematics (C) or science (D).

[c]In 2020, there were 422,971 California public high school graduates in CALPADS. Almost 10 percent of these students (40,496 students) were dropped from this analysis because they did not have data for all four years of high school.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.2

Percentage of 2020 California State University (CSU) Applicants Who Did or Did Not Meet A-G Course Requirements

SUBGROUP (%)	MET A-G	DID NOT MEET A-G		MISSING MATH OR SCIENCE[a]	MISSING OTHER REQUIREMENT[b]	SAMPLE SIZE[c]
All applicants	92.7	7.3		2.6	4.7	136,713
Demographic						
Race and ethnicity						
Black	89.2	10.8	†††	5.1	5.7	5,407
Latinx	91.1	8.9	†††	3.4	5.5	70,561
White	95.5	4.5	†††	1.3	3.2	24,636
Asian[d]	95.0	5.0	†††	1.0	3.9	27,088
Other[e]	93.6	6.4	†††	2.4	4.0	9,021
Gender[f]						
Female	93.2	6.8	†††	2.6	4.2	79,524
Male	92.1	7.9	†††	2.5	5.4	57,185
Socioeconomic status						
Eligible for free/reduced lunch	90.8	9.2	†††	3.5	5.7	71,090
Not eligible	94.8	5.2	†††	1.6	3.6	65,623
Parent education level						
Neither parent attended college	91.2	8.8	†††	3.3	5.6	58,638
At least one parent attended college	93.9	6.1	†††	2.0	4.0	78,075
English proficiency						
English learner	87.4	12.6	†††	5.2	7.4	5,025
Non-English learner	93.0	7.0	†††	2.5	4.6	131,263
School location						
City	92.8	7.2	†††	2.5	4.6	61,851
Suburb	92.9	7.1	†††	2.4	4.7	61,575
Town	91.0	9.0	†††	3.8	5.3	4,863
Rural area	91.1	8.9	†††	3.8	5.0	6,206
High school performance and attendance						
Math proficiency[g]						
Met proficiency	96.0	4.0	†††	0.6	3.4	76,983
Did not meet proficiency	88.6	11.4	†††	5.1	6.3	57,548
High school GPA in math						
3.0 or above	96.8	3.2	†††	0.4	2.8	69,506
Below 3.0	88.5	11.5	†††	4.8	6.6	67,200
High school attendance						
Chronically absent	86.5	13.5	†††	5.6	7.9	7,733
Not chronically absent	93.1	6.9	†††	2.4	4.5	128,933

(continued)

APPENDIX TABLE B.2 (CONTINUED)

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: A chi square test was applied to the estimated difference between meeting A-G and not meeting A-G for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of the total students who missed at least one of the mathematics (C) or science (D) A-G course requirements.

[b]The percentage of the total students who did not meet A-G course requirements because they missed one or more courses other than mathematics (C) or science (D).

[c]The CSU provided a list of 143,355 students that applied to the CSU system in 2020. Five percent of these students (6,642 students) were dropped from this analysis because a match was not found in the CALPADS data after removing students who did not have four years of high school data.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.3

Percentage of 2020 California State University (CSU) Enrollees Who Did or Did Not Meet A-G Course Requirements

SUBGROUP (%)	MET A-G	DID NOT MEET A-G		MISSING MATH OR SCIENCE[a]	MISSING OTHER REQUIREMENT[b]	SAMPLE SIZE[c]
All enrollees	95.6	4.4		1.2	3.2	50,128
Demographic						
Race and ethnicity						
Black	94.9	5.1	†††	1.7	3.4	1,996
Latinx	95.1	4.9	†††	1.4	3.5	28,575
White	96.5	3.5	†††	0.9	2.7	8,196
Asian[d]	96.7	3.3	†††	0.6	2.8	8,453
Other[e]	95.5	4.5	†††	1.5	3.0	2,908
Gender[f]						
Female	95.7	4.3		1.3	3.0	29,820
Male	95.5	4.5		1.1	3.4	20,304
Socioeconomic status						
Eligible for free/reduced lunch	94.9	5.1	†††	1.5	3.6	28,168
Not eligible	96.4	3.6	†††	0.9	2.7	21,960
Parent education level						
Neither parent attended college	94.9	5.1	†††	1.4	3.6	23,819
At least one parent attended college	96.2	3.8	†††	1.0	2.8	26,309
English proficiency						
English learner	92.3	7.7	†††	1.7	6.0	1,651
Non-English learner	95.7	4.3	†††	1.2	3.1	48,335
School location						
City	95.8	4.2	†††	1.2	3.0	21,985
Suburb	95.7	4.3	†††	1.0	3.3	22,836
Town	93.5	6.5	†††	2.1	4.4	2,031
Rural area	94.4	5.6	†††	2.5	3.2	2,463
High school performance and attendance						
Math proficiency[g]						
Met proficiency	96.9	3.1	†††	0.4	2.7	26,136
Did not meet proficiency	94.3	5.7	†††	2.0	3.7	23,405
High school GPA in math						
3.0 or above	97.4	2.6	†††	0.4	2.2	24,663
Below 3.0	93.9	6.1	†††	2.0	4.1	25,462
High school attendance						
Chronically absent	92.5	7.5	†††	2.6	4.8	2,477
Not chronically absent	95.8	4.2	†††	1.1	3.1	47,640

(continued)

APPENDIX TABLE B.3 (CONTINUED)

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: A chi square test was applied to the estimated difference between meeting A-G requirements and not meeting A-G requirements for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of the total students who missed at least one of the mathematics (C) or science (D) A-G course requirements.

[b]The percentage of the total students who did not meet A-G course requirements because they missed one or more courses other than mathematics (C) or science (D).

[c]A list of 52,186 CSU enrollees in 2020 was provided by the CSU. Four percent of these students (2,058 students) were dropped from this analysis because a match was not found in the CALPADS data after removing students who did not have four years of high school data.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.4

Percentage of 2020 High School Graduates Who Met A-G Requirements and Did or Did Not Meet the Proposed Quantitative Reasoning Requirement

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
All graduates	93.8	6.2		1.7	4.5	228,273
Demographic						
Race and ethnicity						
Black	91.3	8.7	†††	1.7	7.1	9,028
Latinx	92.1	7.9	†††	1.6	6.2	110,329
White	94.6	5.4	†††	2.4	3.0	54,901
Asian[d]	97.3	2.7	†††	0.9	1.8	40,792
Other[e]	95.3	4.7	†††	1.6	3.0	13,223
Gender[f]						
Female	93.8	6.2		1.8	4.4	127,497
Male	93.8	6.2		1.5	4.7	100,761
Socioeconomic status						
Eligible for free/reduced lunch	92.4	7.6	†††	1.6	6.0	110,929
Not eligible	95.1	4.9	†††	1.7	3.2	117,344
Parent education level						
Neither parent attended college	92.6	7.4	†††	1.5	5.9	85,952
At least one parent attended college	94.8	5.2	†††	1.7	3.4	134,123
English proficiency						
English learner	89.4	10.6	†††	2.7	7.9	9,899
Non-English learner	94.0	6.0	†††	1.6	4.4	218,374
School location						
City	94.2	5.8	†††	1.4	4.4	99,477
Suburb	93.7	6.3	†††	1.7	4.7	103,943
Town	92.5	7.5	†††	3.2	4.3	9,169
Rural area	92.5	7.5	†††	2.7	4.8	11,899
High school performance and attendance						
Math proficiency[g]						
Met proficiency	97.9	2.1	†††	0.9	1.2	115,758
Did not meet proficiency	89.6	10.4	†††	2.4	8.0	106,985

(continued)

APPENDIX TABLE B.4 (CONTINUED)

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
High school GPA in math						
3.0 or above	98.3	1.7	†††	1.4	0.2	105,153
Below 3.0	89.9	10.1	†††	1.9	8.2	123,102
High school attendance						
Chronically absent	89.8	10.2	†††	2.3	7.9	15,774
Not chronically absent	94.1	5.9	†††	1.6	4.3	212,397

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: A chi square test was applied to the estimated difference between meeting the proposed additional quantitative reasoning requirement and not meeting the proposed requirement for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of students who never attempted an additional quantitative reasoning course beyond the A-G course requirements.

[b]The percentage of students who attempted an additional quantitative reasoning course beyond the A-G course requirements but did not receive a grade in the course of C- or better.

[c]This analysis only includes students with four years of high school data. Nine percent of students were dropped from the full sample of all high school graduates because they were missing data for one or more years.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.5

Percentage of 2020 California State University (CSU) Applicants Who Met A-G Requirements and Did or Did Not Meet the Proposed Quantitative Reasoning Requirement

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
All applicants	96.8	3.2		0.9	2.4	126,798
Demographic						
Race and ethnicity						
Black	94.7	5.3	†††	1.0	4.3	4,821
Latinx	95.7	4.3	†††	0.9	3.4	64,253
White	97.8	2.2	†††	1.1	1.1	23,538
Asian[d]	98.6	1.4	†††	0.6	0.8	25,742
Other[e]	97.2	2.8	†††	1.0	1.8	8,444
Gender[f]						
Female	96.5	3.5	†††	1.0	2.5	74,108
Male	97.1	2.9	†††	0.7	2.2	52,686
Socioeconomic status						
Eligible for free/reduced lunch	95.9	4.1	†††	0.8	3.2	64,559
Not eligible	97.6	2.4	†††	0.9	1.5	62,239
Parent education level						
Neither parent attended college	96.0	4.0	†††	0.8	3.2	53,450
At least one parent attended college	97.3	2.7	†††	0.9	1.8	73,348
English proficiency						
English learner	94.9	5.1	†††	1.0	4.1	4,391
Non-English learner	96.8	3.2	†††	0.8	2.3	122,048
School location						
City	97.1	2.9	†††	0.7	2.2	57,422
Suburb	96.5	3.5	†††	0.9	2.7	57,217
Town	96.1	3.9	†††	1.7	2.1	4,424
Rural area	96.1	3.9	†††	1.6	2.3	5,656
High school performance and attendance						
Math proficiency[g]						
Met proficiency	98.7	1.3	†††	0.6	0.7	73,927
Did not meet proficiency	94.0	6.0	†††	1.2	4.8	50,994
High school GPA in math						
3.0 or above	99.1	0.9	†††	0.8	0.1	67,294
Below 3.0	94.1	5.9	†††	1.0	4.9	59,499

(continued)

APPENDIX TABLE B.5 (CONTINUED)

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
High school attendance						
Chronically absent	94.9	5.1	†††	1.1	4.0	6,687
Not chronically absent	96.9	3.1	†††	0.8	2.3	120,071

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: A chi square test was applied to the estimated difference between meeting the proposed additional quantitative reasoning requirement and not meeting the proposed requirement for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of students who never attempted an additional quantitative reasoning course beyond the A-G course requirements.

[b]The percentage of students who attempted an additional quantitative reasoning course beyond the A-G course requirements but did not receive a grade in the course of C- or better.

[c]This analysis only includes students with four years of high school data. Four percent of students in the full sample of CSU applicants were dropped due to missing data or because a match was not found between the CSU list of applicants and the CALPADS data.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.6

Percentage of 2020 California State University (CSU) Enrollees Who Met A-G Requirements and Did or Did Not Meet the Proposed Quantitative Reasoning Requirement

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
All applicants	96.8	3.2		0.9	2.3	47,921
Demographic						
Race and ethnicity						
Black	95.4	4.6	†††	0.8	3.8	1,894
Latinx	96.2	3.8	†††	0.9	2.9	27,172
White	97.6	2.4	†††	1.1	1.3	7,906
Asian[d]	98.2	1.8	†††	0.7	1.1	8,172
Other[e]	96.7	3.3	†††	1.3	2.1	2,777
Gender[f]						
Female	96.5	3.5	†††	1.0	2.5	28,531
Male	97.2	2.8	†††	0.7	2.1	19,386
Socioeconomic status						
Eligible for free/reduced lunch	96.4	3.6	†††	0.8	2.8	26,741
Not eligible	97.3	2.7	†††	1.0	1.7	21,180
Parent education level						
Neither parent attended college	96.4	3.6	†††	0.8	2.8	22,613
At least one parent attended college	97.1	2.9	†††	1.0	1.9	25,308
English proficiency						
English learner	95.7	4.3	†††	1.3	3.0	1,524
Non-English learner	96.8	3.2	†††	0.9	2.3	46,265
School location						
City	97.2	2.8	†††	0.7	2.0	21,066
Suburb	96.4	3.6	†††	0.9	2.7	21,856
Town	96.3	3.7	†††	1.8	1.9	1,899
Rural area	96.3	3.7	†††	2.0	1.8	2,324
High school performance and attendance						
Math proficiency[g]						
Met proficiency	98.5	1.5	†††	0.6	0.9	25,326
Did not meet proficiency	94.9	5.1	†††	1.2	3.9	22,062
High school GPA in math						
3.0 or above	99.0	1.0	†††	0.8	0.2	24,014

(continued)

APPENDIX TABLE B.6 (CONTINUED)

SUBGROUP (%)	MET QUANT REQUIREMENT	DID NOT MEET REQUIREMENT		NEVER ATTEMPTED[a]	ATTEMPTED BUT DID NOT MEET[b]	SAMPLE SIZE[c]
Below 3.0	94.6	5.4	†††	1.0	4.5	23,904
High school attendance						
Chronically absent	95.1	4.9	†††	1.0	3.8	2,292
Not chronically absent	96.9	3.1	†††	0.9	2.2	45,618

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: A chi square test was applied to the estimated difference between meeting the proposed additional quantitative reasoning requirement and not meeting the proposed requirement for demographic and school performance and attendance subgroups. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]The percentage of students who never attempted an additional quantitative reasoning course beyond the A-G course requirements.

[b]The percentage of students who attempted an additional quantitative reasoning course beyond the A-G course requirements but did not receive a grade in the course of C- or better.

[c]This analysis only includes students with four years of high school data. Four percent of students in the full sample of CSU applicants were dropped due to missing data or because a match was not found between the CSU list of applicants and the CALPADS data.

[d]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[e]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[f]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[g]Math proficiency is measured using scores from the Smarter Balanced eleventh grade assessment.

APPENDIX TABLE B.7

Associations Between Meeting A-G Course Requirements and Student Characteristics, 2020 High School Graduates

CHARACTERISTIC	DEMOGRAPHIC CHARACTERISTICS ONLY	WITH HIGH SCHOOL PERFORMANCE AND ATTENDANCE
Demographic		
Race and ethnicity		
Black	✗	NS
Latinx	✗	✓
Asian[a]	✓	✓
Other[b]	✓	✓
Gender[c]		
Female	✓	✓
Socioeconomic status		
Eligible for free/reduced price lunch	✗	✗
Parent education level		
Neither parent attended college	✗	✗
English proficiency		
English learner	✗	✗
School location		
Suburb	✗	✗
Town	✗	✗
Rural area	✗	✗
High school performance and attendance		
Math proficiency[d]		
Did not meet proficiency	NS	✗
High school GPA in math		
Below 3.0	NS	✗
High school attendance		
Chronically absent	NS	✗

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Associations between meeting A-G requirements and student characteristics are modeled with logistic regression and are relative to the reference group in each category. The association is marked ✓ if it is positive and statistically significant at the 0.10 level. The association is marked ✗ if it is negative and statistically significant at the 0.10 level. "NS" denotes that the association was not significant at the 0.1 percent level. The sample includes 382,475 California public high school graduates in 2020.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[d]Math proficiency is measured using scores from the Smarter Balanced eleventh-grade assessment.

APPENDIX TABLE B.8

Associations Between Meeting the Proposed Quantitative Reasoning Requirement and Student Characteristics, 2020 High School Graduates Who Met A-G Course Requirements

CHARACTERISTIC	DEMOGRAPHIC CHARACTERISTICS ONLY	WITH HIGH SCHOOL PERFORMANCE AND ATTENDANCE
Demographic		
Race and ethnicity		
Black	✘	NS
Latinx	✘	NS
Asian[a]	✓	✓
Other[b]	✓	✓
Gender[c]		
Female	✓	NS
Socioeconomic status		
Eligible for free/reduced price lunch	✘	✘
Parent education level		
Neither parent attended college	✘	NS
English proficiency		
English learner	✘	✘
School location		
Suburb	✘	✘
Town	✘	✘
Rural area	✘	✘
High school performance and attendance		
Math proficiency[d]		
Did not meet proficiency	NS	✘
High school GPA in math		
Below 3.0	NS	✘
High school attendance		
Chronically absent	NS	✘

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Associations between meeting A-G requirements and student characteristics are modeled with logistic regression and are relative to the reference group in each category. The association is marked ✓ if it is positive and statistically significant at the 0.10 level. The association is marked ✘ if it is negative and statistically significant at the 0.10 level. "NS" denotes that the association was not significant at the 0.1 percent level. The sample includes 382,475 California public high school graduates in 2020.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[d]Math proficiency is measured using scores from the Smarter Balanced eleventh-grade assessment.

APPENDIX TABLE B.9

Associations Between Meeting the Proposed Quantitative Reasoning Requirement and Student Characteristics, 2020 California State University (CSU) Applicants Who Met A-G Requirements

CHARACTERISTIC	DEMOGRAPHIC CHARACTERISTICS ONLY	WITH HIGH SCHOOL PERFORMANCE AND ATTENDANCE
Demographic		
Race and ethnicity		
Black	✗	✗
Latinx	✗	✗
Asian[a]	✓	✓
Other[b]	✗	NS
Gender[c]		
Female	✗	✗
Socioeconomic status		
Eligible for free/reduced price lunch	✗	✗
Parent education level		
Neither parent attended college	NS	NS
English proficiency		
English learner	✗	✗
School location		
Suburb	✗	✗
Town	✗	✗
Rural area	✗	✗
High school performance and attendance		
Math proficiency[d]		
Did not meet proficiency	NS	✗
High school GPA in math		
Below 3.0	NS	✗
High school attendance		
Chronically absent	NS	✗

SOURCES: MDRC's calculations use student data from the California Longitudinal Pupil Achievement Data System (CALPADS) from the 2015-2016 through 2019-2020 school years, CSU data from the 2020-2021 school year, and the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Associations between meeting A-G requirements and student characteristics are modeled with logistic regression and are relative to the reference group in each category. The association is marked ✓ if it is positive and statistically significant at the 0.10 level. The association is marked ✗ if it is negative and statistically significant at the 0.10 level. "NS" denotes that the association was not significant at the 0.1 percent level. The sample includes 382,475 California public high school graduates in 2020.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

[d]Math proficiency is measured using scores from the Smarter Balanced eleventh-grade assessment.

APPENDIX TABLE B.10

Differences in Short-Term College Outcomes by Whether Student Met Proposed Quantitative Reasoning Requirement, 2018 and 2019 California State University (CSU) Enrollees

SHORT-TERM COLLEGE OUTCOMES	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE
No covariates				
Passed first college mathematics course (%)				
End of first year	79.7	65.4	14.3***	<0.001
Middle of second year	83.6	69.8	13.7***	<.0001
Still enrolled at CSU (%)				
End of first year	85.9	77.7	8.2***	<0.001
Middle of second year	78.2	66.5	11.7***	<0.001
CSU credits attempted				
End of first year	29.5	27.7	1.8***	<0.001
Middle of second year	42.3	38.2	4.1***	<0.001
CSU credits earned				
End of first year	25.9	21.9	4.0***	<0.001
Middle of second year	37.2	30.3	6.8***	<0.001
Controlling for high school performance and attendance				
Passed first college mathematics course (%)				
End of first year	79.0	76.5	2.5***	<0.001
Middle of second year	83.0	79.9	3.0***	<0.001
Still enrolled at CSU (%)				
End of first year	85.4	85.3	0.2	0.735
Middle of second year	77.6	77.6	0.0	0.990
CSU credits attempted				
End of first year	29.4	29.9	-0.5***	<0.001
Middle of second year	42.0	42.9	-0.9***	<0.001
CSU credits earned				
End of first year	25.7	26.3	-0.6***	<0.001
Middle of second year	36.7	37.9	-1.2***	<0.001
Sample size	101,269	5,848		

(continued)

APPENDIX TABLE B.10 (CONTINUED)

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models labeled "No covariates" do not include high school performance and attendance covariates, while models labeled "Controlling for high school performance and attendance" include covariates for whether a student was proficient in mathematics on the standardized state test, high school grade point average in math, and whether a student was chronically absent in high school. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent.

A list of 113,274 enrollees in 2018 and 2019 was provided by the CSU. Five percent of these students (6,157 students) were dropped from this analysis because a match was not found in the California Longitudinal Pupil Achievement Data System after removing students who did not have four years of high school data.

Rounding may cause slight discrepancies in calculating sums and differences.

APPENDIX TABLE B.11

Differences in Short-Term College Outcomes by Whether Student Met Proposed Quantitative Reasoning Requirement, 2018 and 2019 California State University (CSU) Enrollees Who Met Area C and D Requirements

SHORT-TERM COLLEGE OUTCOMES	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE
No covariates				
Passed first college mathematics course (%)				
End of first year	79.7	67.2	12.5***	<0.001
Middle of second year	83.6	71.3	12.2***	<0.001
Still enrolled at CSU (%)				
End of first year	85.9	77.3	8.5***	<0.001
Middle of second year	78.2	66.3	11.9***	<0.001
CSU credits attempted				
End of first year	29.5	27.5	2.0***	<0.001
Middle of second year	42.3	38.0	4.3***	<0.001
CSU credits earned				
End of first year	25.9	21.9	4.1***	<0.001
Middle of second year	37.2	30.4	6.8***	<0.001
Controlling for high school performance and attendance				
Passed first college mathematics course (%)				
End of first year	79.4	78.2	1.2	0.145
Middle of second year	83.3	81.3	2.1***	0.009
Still enrolled at CSU (%)				
End of first year	85.7	85.0	0.7	0.349
Middle of second year	78.0	77.5	0.5	0.586
CSU credits attempted				
End of first year	29.5	29.7	-0.2	0.104
Middle of second year	42.2	42.7	-0.5*	0.068
CSU credits earned				
End of first year	25.8	26.3	-0.5**	0.028
Middle of second year	37.0	38.0	-1.0***	0.005
Sample size	101,269	2,267		

(continued)

APPENDIX TABLE B.11 (CONTINUED)

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models labeled "No covariates" do not include high school performance and attendance covariates, while models labeled "Controlling for high school performance and attendance" include covariates for whether a student was proficient in mathematics on the standardized state test, high school grade point average in math, and whether a student was chronically absent in high school. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent.

A list of 113,274 enrollees in 2018 and 2019 was provided by the CSU. Five percent of these students (6,157 students) were dropped from this analysis because a match was not found in the California Longitudinal Pupil Achievement Data System after removing students who did not have four years of high school data.

Rounding may cause slight discrepancies in calculating sums and differences.

APPENDIX TABLE B.12

Differences in Long-Term College Outcomes by Whether Student Took a Mathematics Course During Senior Year of High School, 2015 California State University (CSU) Enrollees

LONG-TERM COLLEGE OUTCOMES	QUANTITATIVE SENIOR YEAR[a]	NO QUANTITATIVE SENIOR YEAR[b]	ESTIMATED DIFFERENCE	P-VALUE
No covariates				
Attained a degree (%)				
4 years	27.4	24.8	2.6***	0.001
5 years	55.0	51.9	3.1***	<0.001
6 years	63.4	60.2	3.2***	<0.001
Attained a STEM Degree[c] (%)				
4 years	8.9	3.9	5.0***	<0.001
5 years	20.2	9.8	10.4***	<0.001
6 years	24.1	12.1	12.0***	<0.001
Controlling for high school performance and attendance				
Attained a degree (%)				
4 years	27.3	25.3	2.0***	0.009
5 years	54.9	53.5	1.4	0.104
6 years	63.3	61.8	1.5*	0.073
Attained a STEM degree[c] (%)				
4 years	8.9	4.3	4.6***	<0.001
5 years	20.1	10.9	9.2***	<0.001
6 years	24.0	13.3	10.7***	<0.001
Sample size	45,717	3,580		

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2011-2012 through 2014-2015 school years, CSU data from the 2015-2016 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models labeled "No covariates" do not include high school performance and attendance covariates, while models labeled "Controlling for high school performance and attendance" include covariates for whether a student was proficient in mathematics on the standardized state test, high school grade point average in math, and whether a student was chronically absent in high school. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent.

The CSU provided a list of 52,291 CSU enrollees in 2015. Six percent of these students (2,994 students) were dropped from this analysis because a match was not found in the California Longitudinal Pupil Achievement Data System data after removing students who did not have four years of high school data.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]Students took a quantitative reasoning course during their senior year of high school.

[b]Students did not take a quantitative reasoning course during their senior year of high school.

[c]STEM degrees are degrees in science, technology, engineering, or mathematics.

APPENDIX TABLE B.13

Differences in Passing First College Mathematics Course by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Reasoning Requirement by Subgroup, 2018 and 2019 California State University (CSU) Enrollees, No Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	75.4	61.6	13.8***	<0.001	††	4,299
Latinx	80.5	69.3	11.2***	<0.001	††	58,061
White	88.5	74.5	14.0***	<0.001	††	19,137
Asian[a]	89.2	73.7	15.5***	<0.001	††	18,318
Other[b]	84.2	68.8	15.4***	<0.001	††	7,297
Gender[c]						
Female	83.6	70.7	12.9***	<0.001	††	63,041
Male	83.6	68.3	15.2***	<0.001	††	44,043
Socioeconomic status						
Eligible for free/reduced price lunch	80.4	67.5	12.9***	<0.001		57,160
Not eligible	87.2	73.7	13.5***	<0.001		49,871
Parent education level						
Neither parent attended college	86.1	71.0	15.1***	<0.001	†††	59,430
At least one parent attended college	80.4	68.7	11.7***	<0.001	†††	47,687
School location						
City	82.9	67.8	15.1***	<0.001	†††	46,729
Suburb	85.3	71.4	13.9***	<0.001	†††	48,350
Town	79.9	73.2	6.7***	0.005	†††	4,735
Rural area	80.3	72.3	8.0***	<0.001	†††	5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.14

Differences in Passing First College Mathematics Course by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Reasoning Requirement, by Subgroup, 2018 and 2019 California State University (CSU) Enrollees, with Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	74.4	71.8	2.6	0.283	††	4,299
Latinx	79.9	78.5	1.4**	0.045	††	58,061
White	88.2	82.2	6.0***	<0.001	††	19,137
Asian[a]	89.0	81.3	7.8***		††	18,318
Other[b]	83.5	80.2	3.3*	0.093	††	7,297
Gender[c]						
Female	83.0	79.8	3.3***	<0.001		63,041
Male	83.0	79.9	3.0***	<0.001		44,043
Socioeconomic status						
Eligible for free/reduced price lunch	79.7	79.7	2.5***	<0.001		57,160
Not eligible	86.8	82.9	3.9***	<0.001		49,871
Parent education level						
Neither parent attended college	85.6	80.8	4.7***	<0.001	†††	59,430
At least one parent attended college	79.8	78.3	1.4*	0.066	†††	47,687
School location						
City	82.3	78.8	3.5***	<0.001	††	46,729
Suburb	84.7	81.1	3.6***	<0.001	††	48,350
Town	79.3	81.3	-2.1	0.385	††	4,735
Rural area	79.7	80.2	-0.5	0.833	††	5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.15

Differences in Continued Enrollment at California State University (CSU) by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Requirement, by Subgroup, 2018 and 2019 Enrollees, No Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	71.4	61.3	10.1	<0.001		4,299
Latinx	75.1	64.9	10.2***	<0.001		58,061
White	82.4	73.1	9.3***	<0.001		19,137
Asian[a]	85.1	74.7	10.4***	<0.001		18,318
Other[b]	77.9	63.5	14.4***	<0.001		7,297
Gender[c]						
Female	80.0	68.9	11.1***	<0.001	†	63,041
Male	75.8	62.4	13.4***	<0.001	†	44,043
Socioeconomic status						
Eligible for free/reduced price lunch	75.4	63.7	11.7***	<0.001		57,160
Not eligible	81.5	71.2	10.3***	<0.001		49,871
Parent education level						
Neither parent attended college	80.5	68.7	11.8***	<0.001		59,430
At least one parent attended college	75.4	64.4	11.0***	<0.001		47,687
School location						
City	77.3	63.7	13.6***	<0.001	†††	46,729
Suburb	79.7	68.7	11.1***	<0.001	†††	48,350
Town	78.4	70.4	8.1***	0.001	†††	4,735
Rural area	76.4	71.2	5.2**	0.026	†††	5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.16

Differences in Continued Enrollment at California State University (CSU) by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Requirement, by Subgroup, 2018 and 2019 Enrollees, with Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE	SAMPLE SIZE
Race and ethnicity					
Black	70.4	70.9	-0.4	0.869	4,299
Latinx	74.4	75.3	-0.9	0.250	58,061
White	82.0	82.1	0.0	0.992	19,137
Asian[a]	84.8	83.0	1.8	0.271	18,318
Other[b]	77.3	74.6	2.7	0.232	7,297
Gender[c]					
Female	79.4	78.5	0.9	0.226	63,041
Male	75.1	75.3	-0.2	0.817	44,043
Socioeconomic status					
Eligible for free/reduced price lunch	74.6	74.8	-0.2	0.809	57,160
Not eligible	81.0	80.9	0.1	0.904	49,871
Parent education level					
Neither parent attended college	80.0	79.2	0.8	0.329	59,430
At least one parent attended college	74.7	75.5	-0.8	0.336	47,687
School location					
City	76.6	76.4	0.2	0.837	46,729
Suburb	79.1	79.1	0.0	0.982	48,350
Town	77.9	77.2	0.8	0.748	4,735
Rural area	75.9	78.0	-2.1	0.365	5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.17

Differences in California State University (CSU) Credits Earned by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Requirement, by Subgroup, 2018 and 2019 Enrollees, No Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	32.2	27.3	4.9	<0.001	†††	4,299
Latinx	34.4	29.4	4.9***	<0.001	†††	58,061
White	43.2	35.0	8.3***	<0.001	†††	19,137
Asian[a]	39.9	32.8	7.1***	<0.001	†††	18,318
Other[b]	38.6	29.8	8.8***	<0.001	†††	7,297
Gender[c]						
Female	37.8	31.3	6.5***	<0.001	††	63,041
Male	36.3	28.7	7.6***	<0.001	††	44,043
Socioeconomic status						
Eligible for free/reduced price lunch	34.2	28.9	5.3***	<0.001	†††	57,160
Not eligible	40.5	32.7	7.8***	<0.001	†††	49,871
Parent education level						
Neither parent attended college	39.5	31.5	8.0***	<0.001	†††	59,430
At least one parent attended college	34.2	29.2	5.0***	<0.001	†††	47,687
School location						
City	36.6	29.0	7.6***	<0.001	†††	46,729
Suburb	37.9	31.2	6.8***	<0.001	†††	48,350
Town	37.5	33.3	4.2***	<0.001	†††	4,735
Rural area	36.5	32.6	3.9***	<0.001	†††	5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.18

Differences in California State University (CSU) Credits Earned by the Middle of the Second Year, by Whether Student Met Proposed Quantitative Requirement, by Subgroup, 2018 and 2019 Enrollees, with Covariates

SUBGROUP (%)	MET REQUIREMENT	DID NOT MEET REQUIREMENT	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	31.7	32.4	-0.7	0.451		4,299
Latinx	34.0	34.8	-0.9***	0.002		58,061
White	42.8	43.6	-0.7	0.282		19,137
Asian[a]	39.7	39.4	0.3	0.639		18,318
Other[b]	38.2	38.3	-0.1	0.908		7,297
Gender[c]						
Female	37.4	38.0	-0.6**	0.031	††	63,041
Male	35.8	37.4	-1.6***	<0.001	††	44,043
Socioeconomic status						
Eligible for free/reduced price lunch	33.8	34.4	-0.6**	0.043		57,160
Not eligible	40.1	41.3	-1.2***	0.002		49,871
Parent education level						
Neither parent attended college	39.1	40.1	-1.0***	0.003		59,430
At least one parent attended college	33.8	34.7	-0.8***	0.005		47,687
School location						
City	36.2	37.4	-1.2***	<0.001		46,729
Suburb	37.5	38.6	-1.1***	0.001		48,350
Town	37.1	38.4	-1.3	0.180		4,735
Rural area	36.2	37.1	-0.9	0.310		5,424

SOURCES: MDRC's calculations use the California Department of Education (CDE) student data from the 2013-2014 through 2018-2019 school years, CSU data from the 2018-2019 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[b]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[c]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.19

Differences in Degree Attainment at the End of Six Years, by Whether Student Took a Quantitative Course During Senior Year, by Subgroup, 2015 California State University (CSU) Enrollees, No Covariates

SUBGROUP (%)	QUANTITATIVE SENIOR YEAR[a]	NO QUANTITATIVE SENIOR YEAR[b]	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	50.8	46.7	4.1	0.241	†††	2,221
Latinx	57.3	57.6	-0.3	0.827	†††	24,085
White	72.6	66.9	5.7***	<0.001	†††	10,278
Asian[c]	71.7	66.0	5.7***	0.007	†††	8,557
Other[d]	65.3	56.6	8.7***	0.001	†††	4,152
Gender[e]						
Female	66.4	63.6	2.8***	0.006	†	29,091
Male	59.2	53.4	5.9***	<0.001	†	20,206
Socioeconomic status						
Eligible for free/reduced price lunch	57.1	55.2	1.9	0.125		24,249
Not eligible	69.5	65.1	4.5***	<0.001		24,857
Parent education level						
Neither parent attended college	67.8	62.8	5.0***	<0.001	††	28,261
At least one parent attended college	57.5	56.4	1.1	0.423	††	21,036
School location						
City	61.7	59.3	2.4*	0.058		21,873
Suburb	65.8	61.4	4.5***	<0.001		22,279
Town	63.0	57.1	5.9	0.128		1,888
Rural area	61.0	63.8	-2.9	0.428		2,258

SOURCES: MDRC's calculations use California Department of Education (CDE) student data from the 2011-2012 through 2014-2015 school years, CSU data from the 2015-2016 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]Students took a quantitative reasoning course during their senior year of high school.

[b]Students did not take a quantitative reasoning course during their senior year of high school.

[c]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[d]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[e]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.20

Differences in Degree Attainment at the End of Six Years, by Whether Student Took a Quantitative Course During Senior Year, by Subgroup, 2015 California State University (CSU) Enrollees, with Covariates

SUBGROUP (%)	QUANTITATIVE SENIOR YEAR[a]	NO QUANTITATIVE SENIOR YEAR[b]	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	50.9	46.1	4.8	0.174	††	2,221
Latinx	57.2	58.6	-1.4	0.278	††	24,085
White	72.3	70.5	1.8	1.8	††	10,278
Asian[c]	71.6	67.2	4.4**	0.042	††	8,557
Other[d]	65.2	58.3	6.9**	0.012	††	4,152
Gender[e]						
Female	66.3	64.8	1.5	0.151		29,091
Male	59.1	55.8	3.2**	0.030		20,206
Socioeconomic status						
Eligible for free/reduced price lunch	57.0	56.0	1.0	0.406		24,249
Not eligible	69.3	67.5	1.9*	0.098		24,857
Parent education level						
Neither parent attended college	67.6	65.4	2.2**	0.044		28,261
At least one parent attended college	57.5	56.8	0.6	0.638		21,036
School location						
City	61.7	60.2	1.5	0.244		21,873
Suburb	65.7	63.5	2.2*	0.080		22,279
Town	62.7	60.2	2.5	0.531		1,888
Rural area	60.8	65.4	-4.6	0.196		2,258

SOURCES: MDRC's calculations use California Department of Education (CDE) student data from the 2011-2012 through 2014-2015 school years, CSU data from the 2015-2016 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]Students took a quantitative reasoning course during their senior year of high school.

[b]Students did not take a quantitative reasoning course during their senior year of high school.

[c]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[d]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[e]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.21

Differences in Science, Technology, Engineering, or Mathematics Degree Attainment at the End of Six Years, by Whether Student Took a Quantitative Course During Senior Year, by Subgroup, 2015 California State University (CSU) Enrollees, No Covariates

SUBGROUP (%)	QUANTITATIVE SENIOR YEAR[a]	NO QUANTITATIVE SENIOR YEAR[b]	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	15.3	10.1	5.2**	0.038	†††	2,221
Latinx	17.7	9.8	7.9***	<0.001	†††	24,085
White	30.6	14.9	15.7***	<0.001	†††	10,278
Asian[c]	35.7	18.1	17.6***	<0.001	†††	8,557
Other[d]	25.9	9.9	16.1***	<0.001	†††	4,152
Gender[e]						
Female	21.0	11.2	9.8***	<0.001	†††	29,091
Male	28.4	13.9	14.5***	<0.001	†††	20,206
Socioeconomic status						
Eligible for free/reduced price lunch	19.1	10.7	8.4***	<0.001	†††	24,249
Not eligible	28.9	13.5	15.3***	<0.001	†††	24,857
Parent education level						
Neither parent attended college	27.8	12.3	15.5***	<0.001	†††	28,261
At least one parent attended college	19.1	11.9	7.2***	<0.001	†††	21,036
School location						
City	23.4	12.4	11.1***	<0.001		21,873
Suburb	25.0	12.2	12.8***	<0.001		22,279
Town	24.4	10.0	14.4***	<0.001		1,888
Rural area	23.3	12.1	11.2***	<0.001		2,258

SOURCES: MDRC's calculations use California Department of Education (CDE) student data from the 2011-2012 through 2014-2015 school years, CSU data from the 2015-2016 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]Students took a quantitative reasoning course during their senior year of high school.

[b]Students did not take a quantitative reasoning course during their senior year of high school.

[c]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[d]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[e]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

APPENDIX TABLE B.22

Differences in Science, Technology, Engineering, or Mathematics Degree Attainment at the End of Six Years, by Whether Student Took a Quantitative Course During Senior Year, by Subgroup, 2015 California State University (CSU) Enrollees, with Covariates

SUBGROUP (%)	QUANTITATIVE SENIOR YEAR[a]	NO QUANTITATIVE SENIOR YEAR[b]	ESTIMATED DIFFERENCE	P-VALUE		SAMPLE SIZE
Race and ethnicity						
Black	15.3	10.2	5.1**	0.045	†††	2,221
Latinx	17.6	10.5	7.1***	<0.001	†††	24,085
White	30.3	18.2	12.1***	<0.001	†††	10,278
Asian[c]	35.7	18.1	17.6***	<0.001	†††	8,557
Other[d]	25.8	11.0	14.8***	<0.001	†††	4,152
Gender[e]						
Female	20.9	12.1	8.9***	<0.001	†	29,091
Male	28.3	16.4	11.9***	<0.001	†	20,206
Socioeconomic status						
Eligible for free/reduced price lunch	19.1	11.3	7.8***	<0.001	†††	24,249
Not eligible	28.7	15.4	13.3***	<0.001	†††	24,857
Parent education level						
Neither parent attended college	27.6	14.6	13.0***	<0.001	†††	28,261
At least one parent attended college	19.2	11.9	7.3***	<0.001	†††	21,036
School location						
City	23.4	13.4	10.0***	<0.001		21,873
Suburb	24.9	13.7	11.2***	<0.001		22,279
Town	24.2	11.7	12.5***	<0.001		1,888
Rural area	23.2	13.1	10.1***	0.001		2,258

SOURCES: MDRC's calculations use California Department of Education (CDE) student data from the 2011-2012 through 2014-2015 school years, CSU data from the 2015-2016 through 2020-2021 school years, as well as school-level data from the National Center for Education Statistics' Common Core of Data (CCD).

NOTES: Estimated differences are regression-adjusted using ordinary least squares. Models do not include high school performance and attendance covariates. Statistical significance levels are indicated as: *** = 1 percent; ** = 5 percent; and * = 10 percent. Statistical significance levels for differences between subgroup categories are indicated as: ††† = 1 percent; †† = 5 percent; and † = 10 percent.

Rounding may cause slight discrepancies in calculating sums and differences.

[a]Students took a quantitative reasoning course during their senior year of high school.

[b]Students did not take a quantitative reasoning course during their senior year of high school.

[c]"Asian" includes students who identified as Asian, Pacific Islander, or Filipino.

[d]"Other" includes students who identified as American Indian or Alaska Native, two or more races or multiracial, or not reported or unknown.

[e]A small number of students had a gender value of nonbinary. These students were not included in this gender subgroup analysis because there were so few of them.

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ABOUT MDRC

MDRC, A NONPROFIT, NONPARTISAN SOCIAL AND EDUCATION POLICY RESEARCH ORGANIZATION, IS COMMITTED TO finding solutions to some of the most difficult problems facing the nation. We aim to reduce poverty and bolster economic mobility; improve early child development, public education, and pathways from high school to college completion and careers; and reduce inequities in the criminal justice system. Our partners include public agencies and school systems, nonprofit and community-based organizations, private philanthropies, and others who are creating opportunity for individuals, families, and communities.

Founded in 1974, MDRC builds and applies evidence about changes in policy and practice that can improve the well-being of people who are economically disadvantaged. In service of this goal, we work alongside our programmatic partners and the people they serve to identify and design more effective and equitable approaches. We work with them to strengthen the impact of those approaches. And we work with them to evaluate policies or practices using the highest research standards. Our staff members have an unusual combination of research and organizational experience, with expertise in the latest qualitative and quantitative research methods, data science, behavioral science, culturally responsive practices, and collaborative design and program improvement processes. To disseminate what we learn, we actively engage with policymakers, practitioners, public and private funders, and others to apply the best evidence available to the decisions they are making.

MDRC works in almost every state and all the nation's largest cities, with offices in New York City; Oakland, California; Washington, DC; and Los Angeles.