ADVANCED INNOVATIVE MATH COURSES

# Discrete Math for Pre-College Students

**Discrete Math for Pre-College Students (DMPC)** is a course developed by a team based at San Diego State University and intended for students who are college-bound, have completed Integrated Math III with a grade of C or better and are undecided about whether to pursue a degree in a STEM discipline in college. Designed to "foster students' mathematical curiosity" and demonstrate how mathematics can be applied in their lives, the course introduces topics and concepts from discrete mathematics using problem-solving, sense-making, modeling, and reasoning.

### Topics of Study

- Two-Player Impartial Games
- Graph Theory
- Iteration and Recursion
- Cryptography
- Counting

## Who Enrolls in DMPC?

The DMPC course was initially piloted in the 2017–18 academic year in the Sweetwater Union High School District, where most enrollees are today. Over 1,060 seniors enrolled in DMPC in 2018–19. As the summary figures from 2018–19 enrollment show, the course is serving a high percentage of Latinx students as well as students who have not yet met the state standards in mathematics.

Over **1,000** 12th graders enrolled in DMPC in 2018–19 (16% of seniors in the schools offering the course)

**80%** of enrollees identified as Latinx (compared to 74% of seniors in the cohort)

**59%** of enrollees were designated as socioeconomically disadvantaged (the same percentage as in the cohort)

**18%** of 12th graders enrolled in DMPC *Met* or *Exceeded Standards* on math SBAC (compared to 31% of seniors in the cohort)

**88%** of 12th graders enrolled in DMPC took Algebra 2/ Integrated Math III the previous year

To better understand who the students are who enroll in DMPC, it is helpful to understand the distribution of 12th graders across the different math courses. The figures that follow provide information on characteristics of twelfth grade math enrollment for all students in schools offering DMPC.

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**Table 1. 12th Grade Math Enrollment in Schools Offering DMPC**

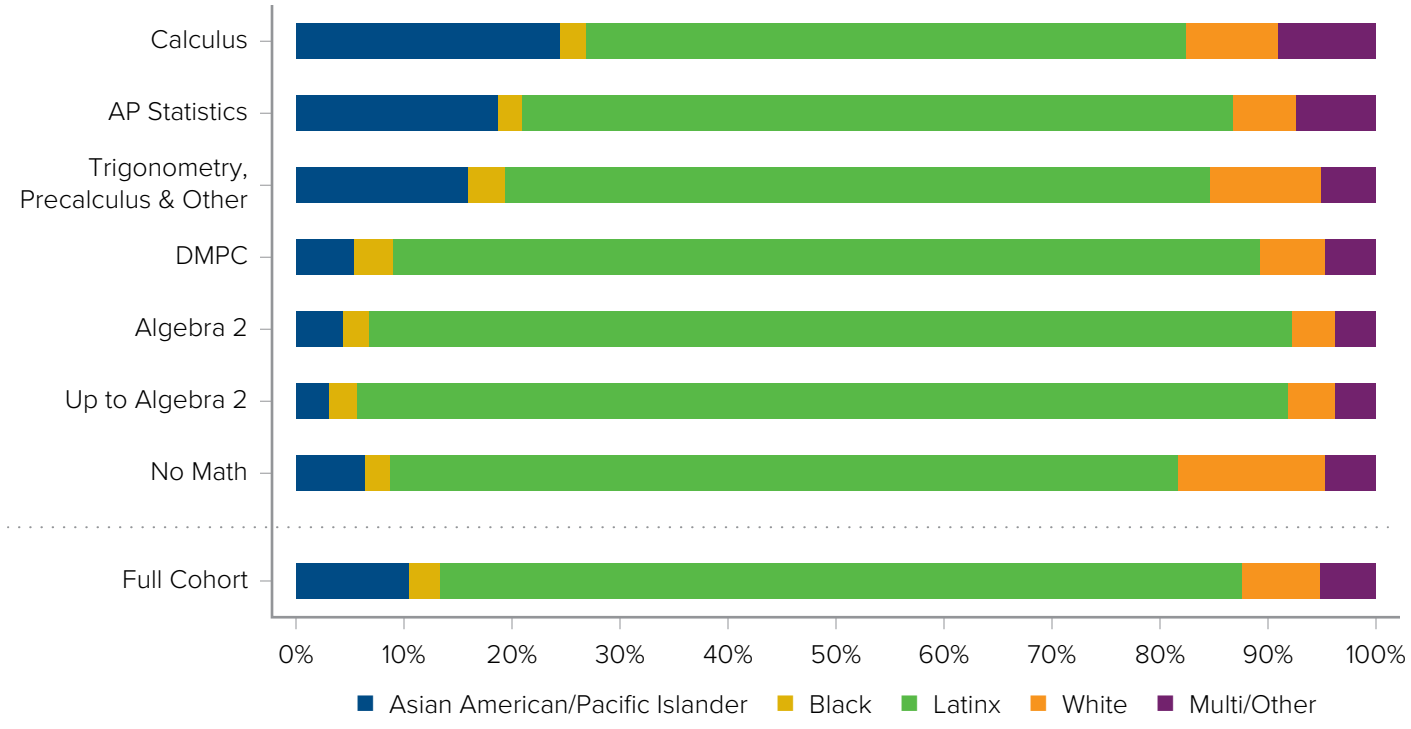
| Math Course Category | Percent of 12th Graders Enrolled | |
|---|---|---|
| | 2017–18 | 2018–19 |
| Advanced Math Courses | | |
| Calculus | 17 | 11 |
| AP Statistics | 12 | 10 |
| Statistics | 0 | 0 |
| Trigonometry, Precalculus & Other | 13 | 24 |
| **DMPC** | **19** | **16** |
| Algebra 2 | 28 | 28 |
| Up to Algebra 2 | 8 | 9 |
| No Math | 11 | 11 |
| **Total 12th Graders** | **6,226** | **6,637** |

Note: Percentages do not add to 100% because some students enroll in more than one math course.

## DATA

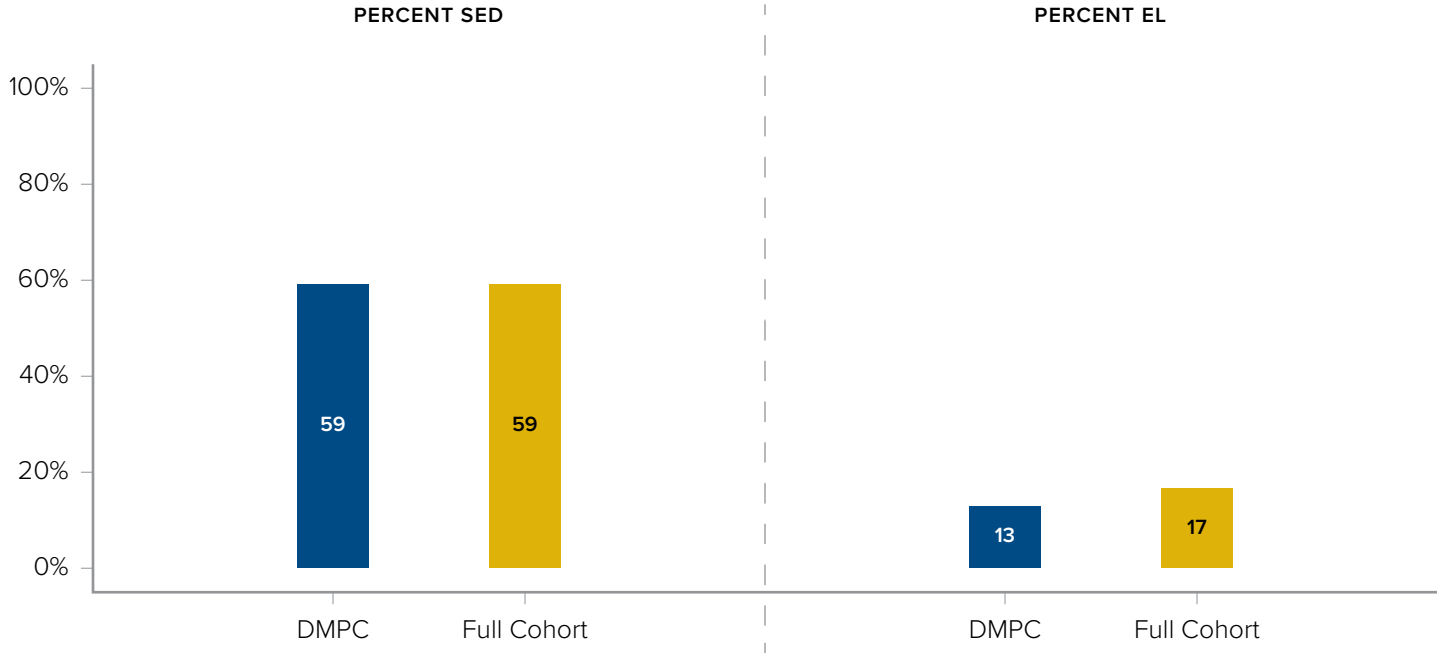
Statistics calculated from student-level and course-level data in the California Longitudinal Pupil Achievement Data System (CALPADS). Figures 1 through 3 include 12th graders in the 2018–19 academic year derived from participation in the 11th grade Smarter Balanced Assessments (SBAC) in 2017–18. Statistics may vary from other reports due to sample differences and data limitations.

**Figure 1. Racial/Ethnic Composition of 12th Grade Math Courses in Schools Offering DMPC**



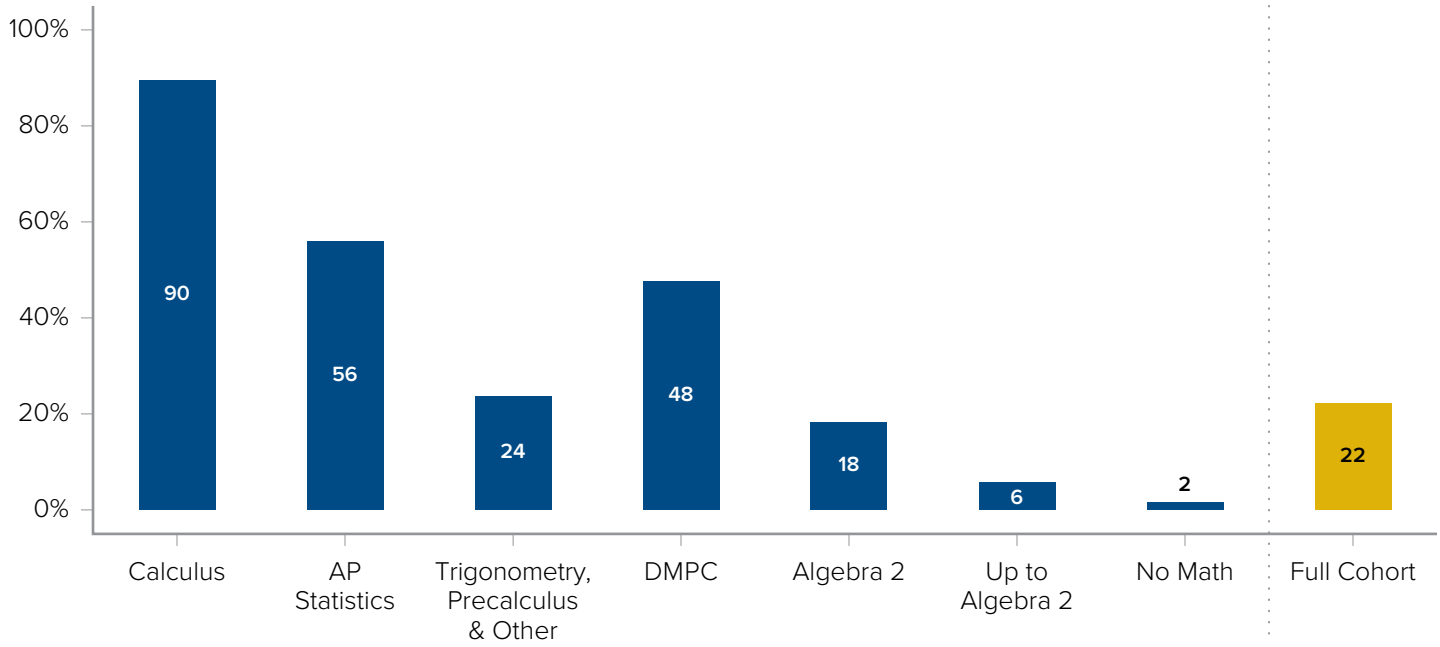

Note: Multi/Other includes students of Native American ancestry, students who identify with multiple racial/ethnic groups, and those for whom race/ethnicity information is missing.

**Figure 2. Percent of SED and EL Students in 12th Grade DMPC Courses Compared to Full Cohort in Schools Offering DMPC**




Notes: SED = Socioeconomically disadvantaged. EL = English Learner. SED status is defined by the California Department of Education as students who either qualify for the free or reduced-price school lunch program or do not have a parent who graduated from high school. For our analysis, we use the student-level SED and EL identifiers in the 11th grade SBAC data.

**Figure 3. Percent of Students Meeting or Exceeding 11th Grade Standards on SBAC Math by 12th Grade Math Courses Enrollment in Schools Offering DMPC**




Note: Students included in this figure achieved *Met Standard* (level 3) or *Exceeded Standard* (level 4) on the 11th grade math SBAC and were enrolled in high school courses the following year.

## What Do Teachers Say about Discrete Math?

While data on how well these students have done once they matriculated to college is not available, teachers have been very positive about the impacts they have seen in the classroom to date. Several teachers note that the pedagogical approach used in the course, one that is not just focused on getting the right answer but on understanding different ways to approach a problem, allows students to explore mathematics differently than they had previously:

> **We're able to stay with a problem longer and a huge part of [the benefit] is that it's never about the answer, it's about why the answer is true.**
>
> **(Discrete Math Teacher)**

Teachers suggest that this deeper dive has a positive impact on students, particularly those who have not typically seen themselves as being strong in mathematics:

> **We do get a lot of student comments about how successful they feel. For the first time they can come to believe that they can do mathematic and that mathematics is not... [just] about being a human computer.**
>
> **(Discrete Math Teacher)**

Further, teachers believe that this newfound belief that they can be successful in mathematics will help to better set these students up for success in college:

> **It's just very rewarding...to see so many kids having...a better, more positive experience with math [before] going off to college. If they are going to have to take math in college even just to satisfy their [General Education requirements] to have a change in their attitude towards mathematics is huge.**
>
> **(Discrete Math Teacher)**

For more information on teachers' experiences with DMPC, see our **full report on teacher perspectives**.

## What Is the Impact of Discrete Math for Students?

**Analysis of DMPC and similar courses reveals a consistent positive story for students enrolled in advanced innovation math (AIM) curricula.**

Leveraging high school course-taking data along with a rich set of student- and school-level characteristics linked to postsecondary enrollment data allowed for a causal analysis of the impact of enrollment in six AIM courses on key high school and postsecondary outcomes, including grades in 12th grade math courses, UC/CSU eligibility (completion of A–G course requirements), and college enrollment. Methods included advanced matching techniques to compare students enrolling in an AIM course to those who enroll in other (or no) math courses, controlling for a variety of factors that likely influence both math course placement and our outcomes of interest (e.g., prior student achievement in math as measured by test scores, previous math courses, demographic characteristics). Analyses for each AIM course were conducted respectively, and cannot be directly compared given unique course content, schooling environment, and the number of students and schools served. However, all courses demonstrate a positive impact for various postsecondary outcomes.

Results of these analyses indicate that AIM courses provide an additional math pathway that supports students' readiness for and, in some cases, increases in college enrollment. Specifically, AIM courses increase the likelihood that a student will meet the course requirements for UC/CSU eligibility by 3 to 10 percentage points. In some cases, AIM course enrollment improves grades in 12th grade math courses and increases the likelihood of college enrollment. Even when strong evidence of a positive impact on grades is absent, results are still promising. In fact, we may expect that rigorous curricula can engage and challenge students, which could result in a shift in grades, while increasing college preparation. Nevertheless, we are cautious about interpreting changes in grades given the many factors (i.e., teachers, peers, homework time, motivation) that influence grades and the observed effects of the AIM courses are small in magnitude. Moreover, there is limited potential for 12th grade math course performance to change college enrollment trajectories given fall due dates of four-year college applications.

**3 to 10**

percentage-point increase in likelihood of meeting A–G course requirements

**Overall, early evidence of DMPC and similar courses is clearly promising: AIM courses contribute positively to student outcomes, offering students alternatives to traditional calculus pathways and increasing four-year college eligibility.**

For more information on the development and implementation of DMPC and the other AIM courses, see our **full report**.

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For more information on these courses or the statistics included in this report, contact Sherrie Reed at **slreed@ucdavis.edu**.