

**Office of the President**

**TO MEMBERS OF THE ACADEMIC AND STUDENT AFFAIRS COMMITTEE:**

## **DISCUSSION ITEM**

*For Meeting of November 15, 2023*

### **MATH PREPARATION AND UNDERGRADUATE ADMISSIONS**

#### **EXECUTIVE SUMMARY**

The purpose of this item is to provide information about the shared governance process through which University policies and practices are developed to support students' preparation for college admissions and postsecondary academic success, with a spotlight on UC's mathematics admission requirement.

#### **BACKGROUND**

Articulation is the practice of aligning curriculum across educational segments to support students' transition from one segment to another. The high school articulation process allows UC and K–12 faculty in California to align their expectations of student learning outcomes and prepare students for undergraduate studies.

#### **The A–G Subject Requirements**

To be considered for admission to the University of California or the California State University, high school students must complete a minimum of 15 academic courses across seven subject areas. These are commonly referred to as the A–G subject requirements because each letter corresponds to a distinct subject as outlined in UC Academic Senate Regulation 424.A.3,<sup>1</sup> which describes the academic requirements for admission for graduates of secondary schools in California. The A–G course pattern is meant to ensure students are well prepared to participate fully in their first-year program at the University in a wide variety of academic disciplines.

In addition, it is through coursework approved by UC that high school students demonstrate they have attained a body of general knowledge that will provide breadth to and perspective on more advanced learning in college. And finally, taking A–G courses helps high school students develop key study skills and gives them practice in critical thinking and analysis, positioning them for successful postsecondary study and future careers.

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<sup>1</sup> UC Academic Senate Regulation 424.A.3: <https://senate.universityofcalifornia.edu/bylaws-regulations/regulations/rpart2.html#r424>

Per UC Academic Senate Bylaw 145,<sup>2</sup> a major duty of the faculty Board of Admissions and Relations with Schools (BOARS) is to oversee an annual process whereby secondary schools in California are required to submit for approval a list of courses certified by the school as fulfilling the subject requirements for UC admission. For several decades, BOARS has delegated course reviews to the High School Articulation unit at the UC Office of the President, while maintaining policy authority over the approval criteria. To date, approximately 225,000 A–G courses total have been approved across more than 2,500 high schools and programs statewide. Each year, between 20,000 to 35,000 new courses and course revisions of previously approved courses are submitted to UC High School Articulation for review.

All approved courses are aligned with UC’s A–G course criteria, as determined by BOARS and posted on the A–G Policy Resource Guide website.<sup>3</sup> Once courses are approved, they are managed by school and/or district staff on each school’s official A–G Course List published by UC.<sup>4</sup> Since 2014, the High School Articulation unit has administered the annual A–G course submission and review process via UC’s A–G Course Management Portal,<sup>5</sup> which not only streamlines the A–G course review process, but also serves as a collaborative, statewide K–12 resource for college-prep curriculum design.

### **The Interconnections of A–G & Common Core**

The A–G course criteria and the goals of the A–G subject requirements for UC admissions are consistent with the goals underlying the Common Core State Standards that the State Board of Education adopted in 2010 as the new college-preparatory standards in mathematics and English language arts for California’s public K–12 schools. In 2013–14, the UC Academic Senate and High School Articulation engaged in several initiatives to update UC policy and promote students’ A–G course-taking patterns in support of statewide Common Core implementation.

BOARS partnered with UC High School Articulation to convene faculty discipline workgroups to revise the course criteria for A–G reviews so that they align with the new Common Core standards, as well as with college-prep content standards in other subjects, including science, world languages, and visual and performing arts. Six workgroups were formed to cover each of the A–F subject areas and address changes to the criteria and guidelines, as needed, for courses that fulfilled the A–G requirements. Draft changes were further reviewed by K–12, California State University, and UC constituents before BOARS approved the updated course policies for the upcoming A–G course submission cycle.

In addition, BOARS issued two statements to clarify its support for the use of Common Core standards in K–12 mathematics instruction and as an appropriate guide for college preparation in math. First, BOARS released a statement on high school mathematics curriculum development affirming UC’s acceptance of both the traditional (Algebra I–Geometry–Algebra II) and

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<sup>2</sup> UC Academic Senate Bylaw 145. Board of Admissions and Relations with Schools: <https://senate.universityofcalifornia.edu/bylaws-regulations/bylaws/blpart2.html#bl145>

<sup>3</sup> A–G Policy Resource Guide website: <https://hs-articulation.ucop.edu/guide>

<sup>4</sup> A–G Course Lists website: <https://hs-articulation.ucop.edu/agcourselist>

<sup>5</sup> A–G Course Management Portal website: <https://hs-articulation.ucop.edu/agcmp#/login>

integrated (Mathematics I–II–III) math course sequences as sufficient for approval in the mathematics subject area (area C), provided that they satisfy the course criteria for mathematics presented on the A–G Policy Resource Guide website.<sup>6</sup> BOARS’ second statement on basic math for all admitted UC students affirmed its position that UC transfer students should also provide evidence of completion of a mathematics background equivalent to three years of Common Core math-aligned coursework.<sup>7</sup>

Both statements emphasize UC’s requirement of three foundational years of college-preparatory math that includes or integrates topics covered in algebra and geometry, including courses that draw from higher-level math, such as trigonometry, probability, and statistics. These statements also underscored the need for UC to consider its position on academic preparation in relation to the K–12 and other postsecondary education segments in the state. This is especially important in the context of new curriculum reform movements, given that innovative approaches to learning may prompt reshaping A–G policies and practices for the next generation of students.

### **AREA C: MATHEMATICS**

#### **Advanced Mathematics**

California’s Common Core standards emphasize learning math in the context of real-world situations, using mathematics to solve problems, and developing “habits of mind” that foster mastery of mathematics content as well as mathematical understanding. Given this K–12 landscape for math preparation and the growing number of inquiries about the types of math courses that could fulfill UC’s math admissions requirement, UC High School Articulation convened a workgroup of UC mathematics and statistics faculty in spring 2020 to confirm the types of high school math courses UC will accept to fulfill the area C subject requirement.

The workgroup did not consider altering the fundamental area C requirement for three courses that cover topics in elementary and advanced algebra and two- and three-dimensional geometry, as defined by UC Academic Senate Regulation 424.A.3.C.<sup>8</sup> However, due to the emergence of diverse college-preparatory math courses beyond the traditional or integrated three-course math pathways, the focus was on providing guidance on the types of high school math courses that qualify for approval in area C’s advanced math discipline categories: Calculus, Computer Science, Pre-Calculus, Statistics, or Other Advanced Mathematics.

The faculty workgroup developed and unanimously supported a clarified definition of “advanced mathematics” for area C. Based on the proposed updates, high school courses approved in any of the five advanced math categories must satisfy all of the following criteria:

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<sup>6</sup> BOARS Statement on High School Mathematics Curriculum Development under the Common Core State Standards:

<https://senate.universityofcalifornia.edu/files/committees/boars/BOARSonCCSSMathCourseDevelopment.pdf>

<sup>7</sup> BOARS Statement on Basic Math for all Admitted UC Students:

<https://senate.universityofcalifornia.edu/files/committees/boars/BOARSStatementonBasicMath.pdf>

<sup>8</sup> UC Academic Senate Regulation 424.A.3.C: <https://senate.universityofcalifornia.edu/bylaws-regulations/regulations/rpart2.html#r424>

- Use mathematical concepts from prerequisite courses (i.e., build upon content covered in elementary algebra, two- and three-dimensional geometry, and advanced algebra);
- Substantially align with Common Core (+) standards for higher mathematics;
- Be designed for 11th and/or 12th grade levels;
- Consist of pure mathematics or its application in science or career technical education; and
- Strengthen students' understanding of mathematics by incorporating the depth described in the *Statement on Competencies in Mathematics Expected of Entering College Students*,<sup>9</sup> endorsed by faculty from UC, the California State University, and the California Community Colleges through the Intersegmental Committee of the Academic Senates (ICAS).

Examples of advanced math include, but are not limited to, courses in applied mathematics (e.g., mathematics of engineering), calculus, computer science, discrete mathematics, linear algebra, pre-calculus, probability, statistics/data science, and trigonometry.

BOARS unanimously endorsed these area C policy changes, intending to expand high school math course options for students as part of both college preparation and equity goals. In October 2020, UC announced the updated mathematics course policy, effective for the 2021–22 school year and onward.<sup>10</sup> Overall, the area C policy revisions aimed to:

- Clarify UC's expectations for college-preparatory mathematics courses that will help students acquire specific skills to master the subject's content and also gain proficiency in quantitative thinking and analysis;
- Align with the efforts of high schools—especially public schools that have implemented the California Common Core State Standards in Mathematics—to design and deliver multiple college-preparatory math course options for students; and
- Invite the submission of a broader range of higher-level and/or honors-level math courses for area C consideration in any of the advanced math categories.

The revised area C policy not only clarified qualifying advanced math courses, but also affirmed that students could complete such courses as early as their junior year to fulfill the minimum admissions requirement of three years of high school math through Algebra II or Mathematics III. This practice, known as “validation,” allows students to complete a more advanced course within an A–G subject area and use that course to satisfy a lower-level course requirement, so long as such advanced courses build upon knowledge acquired in lower-level coursework. Validation is identified as one of several alternate ways to complete the A–G subject requirements, as outlined in UC Academic Senate Regulation 428.C.<sup>11</sup>

By clarifying the definition of advanced math and expanding the choices of area C math courses

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<sup>9</sup> ICAS Statement on Competencies in Mathematics Expected of Entering College Students: <https://icas-ca.org/wp-content/uploads/2020/05/ICAS-Statement-Math-Competencies-2013.pdf>

<sup>10</sup> UC High School Articulation Special Bulletin, October 2020: <https://mailchi.mp/ucop/mathematics-c-announcement>

<sup>11</sup> UC Academic Senate Regulation 428.C: <https://senate.universityofcalifornia.edu/bylaws-regulations/regulations/rpart2.html#r428>

students may take for UC admissions eligibility, students can be encouraged to pursue the mathematics education most relevant to their academic and career goals. Based on expanded options, below are sample course sequences students could complete to fulfill the area C requirement:

*Example 1:* Math I → Math II → Statistics

*Example 2:* Math I → Math II → Math III → Statistics

*Example 3:* Algebra I → Geometry → Algebra II → Introduction to Data Science

*Example 4:* Algebra I → Geometry → Algebra II → Pre-Calculus

*Example 5:* Geometry → Algebra II → Introduction to Data Science → Statistics

*Example 6:* Algebra I → Geometry → Algebra II/Pre-Calculus → Calculus

### **The K–12 California Mathematics Framework & Area C**

In November 2021, UC High School Articulation convened another workgroup of UC mathematics and statistics faculty on behalf of BOARS to address questions about how students can meet (or exceed) the area C requirement, especially in light of the proposed *Mathematics Framework for California Public Schools: Kindergarten Through Grade Twelve (Mathematics Framework)*. This framework document was to be presented to the State Board of Education in July 2022 as a revised blueprint for how high school math courses taught in California public schools might be designed. As such, the potential changes to how Common Core math standards could be addressed clearly warranted UC’s review and consideration with respect to area C.

After several months of deliberation and direct consultation with the framework’s lead authors, the workgroup delivered a letter and recommendations to BOARS in May 2022 regarding their concerns about the *Mathematics Framework*. Subsequently, in July 2022, BOARS conveyed to the State Board of Education its agreement with the workgroup that no changes to the area C requirement were needed, given the flexibility of area C to accommodate new math courses aligned with the proposed *Mathematics Framework*.

BOARS also conveyed feedback about the framework itself, expressing reservations about the proposed new math pathway, *Mathematics: Investigating and Connecting*, which intended to incorporate more data science into mathematics. Both BOARS and the faculty workgroup found this new pathway underdeveloped pedagogically, especially when compared to the existing integrated math pathway. Additionally, BOARS was concerned that promotion of this new pathway could divert resources at economically disadvantaged schools and also divert students from an algebra- and calculus-focused pathway, due to the lack of advanced algebra content in many statistics courses. BOARS noted that this potential gap in academic preparation could have negative impacts in time to degree once at UC and advised that careful communications and counseling will be necessary at the high school level.

The State Board of Education postponed approval of the proposed *Mathematics Framework* and instead spent another year revising the framework document. In July 2023, it voted to approve an updated *Mathematics Framework* (without the new integrated math pathway).<sup>12</sup>

### Data Science Courses

Simultaneously, in July 2023, BOARS was deliberating on concerns regarding certain data sciences courses within area C.<sup>13</sup> Discussions centered around whether currently approved data science courses met the advanced math criteria and could fulfill the third year of the area C requirement through validation. BOARS concluded in July 2023 that data science courses approved in the Statistics or Other Advanced Mathematics categories could not validate a lower-level area C math course (like Algebra II or Mathematics III), unless they included prerequisite mastery of relevant advanced algebra content.<sup>14</sup>

To guide the identification of data science courses eligible to retain area C advanced math approval, and to reaffirm foundational math preparation for postsecondary studies, BOARS convened an area C workgroup in fall 2023. The group aims to review UC’s definition of advanced mathematics for college preparation, clarify validation criteria, determine UC’s definition of foundational mathematics for college preparation, and engage California State University faculty and the ICAS Mathematics Competencies Subcommittee<sup>15</sup> to align expectations of college preparation in math across the education segments in California.

### CONCLUSION

There are various ways to address the college-ready standards of California’s Common Core and to meet UC’s area C course criteria. As such, UC will continue to urge schools to update and adapt mathematics instruction in ways that support every student’s success. What matters most is that students meet the Common Core standards and UC’s expectations underlying the mathematics subject requirement—not that they have completed a specific course sequence. The ultimate goal is to provide California students with diverse math course options, allowing them to choose the most relevant learning path for their educational aspirations at UC or beyond.

### KEY TO ACRONYMS

BOARS	Board of Admissions and Relations with Schools
ICAS	Intersegmental Committee of the Academic Senates

<sup>12</sup> California Department of Education press release on the State Board of Education’s approval of the revised *Mathematics Framework*: <https://www.cde.ca.gov/nr/ne/yr23/yr23rel54.asp>

<sup>13</sup> BOARS July 7, 2023 meeting minutes: [https://senate.universityofcalifornia.edu/\\_files/committees/boars/boars-july-7-2023-minutes.pdf](https://senate.universityofcalifornia.edu/_files/committees/boars/boars-july-7-2023-minutes.pdf)

<sup>14</sup> BOARS July 17, 2023 meeting minutes: [https://senate.universityofcalifornia.edu/\\_files/committees/boars/boars-july-17-2023-minutes.pdf](https://senate.universityofcalifornia.edu/_files/committees/boars/boars-july-17-2023-minutes.pdf)

<sup>15</sup> The ICAS Mathematics Competencies Subcommittee includes mathematics faculty from all three public postsecondary systems and representatives from the California Department of Education.