



CALCULATING THE ODDS:

COUNSELOR VIEWS ON MATH COURSE TAKING AND COLLEGE ADMISSIONS

By Pamela Burdman and Veronica Anderson

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JUST  EQUATIONS

NACAC

"The advice is to err on the side of more perceived rigor in math when possible. I'd love for that to change to a broader range of courses fitting the bill on the math front but that hasn't happened at the college level much at all and therefore not at high schools and certainly not in the views of students and families."

– independent counselor

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ABOUT JUST EQUATIONS

Just Equations reconceptualizes the role of mathematics in ensuring education equity for students. An independent resource on the equity dimensions of math education in the transition from high school to college, Just Equations advances evidence-based strategies to ensure that math policies give all students the quantitative foundation they need to succeed in college and beyond. Just Equations' work is supported by College Futures Foundation, the Bill & Melinda Gates Foundation, and Valhalla Foundation.

ABOUT NACAC

The National Association for College Admission Counseling (NACAC), founded in 1937, is an organization of more than 25,000 professionals from around the world dedicated to serving students as they make choices about pursuing postsecondary education.

ABOUT THE AUTHORS

Pamela Burdman, founder of Just Equations, is a policy analyst and strategist on college access, readiness, and success, with a focus on equity in mathematics. She works at the intersection of education research, policy, and practice to synthesize knowledge from the field to define problems and advance strategies to support student success. She began her career as a reporter for the San Francisco Chronicle more than 20 years ago and first focused on math opportunity as a program officer at the William and Flora Hewlett Foundation.

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EXECUTIVE SUMMARY

Calculus is the study of change—continuous, infinitesimal change. It is the key to measuring phenomena as diverse as epidemics, acoustics, and planetary motion. But since calculus was catapulted to the top of the academic heap more than 50 years ago, little has changed in terms of the course’s role as a hallmark of intelligence and academic rigor. Selective colleges use it as a gatekeeper, and high school students scramble to take the course and succeed.

Math education leaders have challenged these patterns for years. The fixation on calculus can interfere with development of foundational math skills, exacerbate educational inequities, and exert needless pressure on many students to rush through the math curriculum. It also reflects a preoccupation with exclusivity that is tainted by stereotypes about academic ability. Lastly, it interferes with development of substantive math options for the majority of college students—those not pursuing STEM majors and careers.

This report is the second in a series examining preferences for calculus in the college admissions process. The first, [A New Calculus for College Admissions](#), revealed that, even though colleges rarely require calculus for incoming students, many selective colleges still prefer that students have the course on their transcripts, significantly raising the stakes for students’ high school math enrollment decisions. Signals sent by elite colleges attract disproportionate attention, influencing the entire admissions landscape, including the practices of colleges that admit the majority of applicants.

ABOUT THIS REPORT

The current report examines how high school counselors interpret admissions offices’ expectations, driving them to advise students to maximize calculus opportunities. Its conclusions are based on surveys and interviews conducted in partnership with the National Association for College Admission Counseling.

HIGH SCHOOL MATH: THE COUNSELING CONTEXT

As long as calculus remains overvalued in college admissions, students without access to it can be at a disadvantage in the college application process. Calculus is not universally available, with students experiencing poverty and Black, Latinx, and Indigenous students facing the longest odds of taking the course. Students attending public schools are less likely to take the course than those attending private schools. Even at schools that offer calculus, placement practices and scheduling constraints can limit access.

Scant availability of counseling for college planning at some schools contributes to these barriers, especially for students and families who are not in the know about college expectations. The problem begins as early as middle school, because few high schools have pathways to calculus for students who didn’t take Algebra I in middle school.

This report underscores this inequitable dynamic by highlighting the support and guidance about math course selection available to students at schools that do emphasize college planning. These high schools and their counselors and students collectively help shape the competition for spots at in-demand colleges.

INSIGHTS FROM COUNSELORS

The counselor interviews and surveys yielded insights into the role of math in the admissions process:

For most high school counselors, calculus is a default recommendation. Respondents valued calculus nearly universally, but particularly for students applying to selective institutions, even though they did not believe the course is academically necessary for all students. Most advise students with selective colleges in their sights to take at least one calculus course, ideally an Advanced Placement course. The top reason was to ensure students are competitive for the colleges they want to attend—

especially students seeking to major in STEM and business, but often even for those interested in the humanities or social sciences.

Counselors participating in the survey, who tend to represent high schools focused on selective college admissions, were even more likely than our sample of admissions officers to value calculus:

While **93 percent of high school counselors** said calculus gives students an edge in admissions, only **53 percent of admissions officers** in our prior study said the same.

Likewise, when asked whether not taking calculus in high school narrows students' college options, **73 percent of high school counselors** agreed or somewhat agreed, compared to just **34 percent of admissions officers**.

Many counselors believe colleges covertly expect calculus. Some selective institutions—including Stanford, Harvard, and the University of California—have made efforts to clarify that calculus is not an admissions requirement. Nevertheless, many counselors have concluded, based on their own experiences, that the course is at least strongly expected at highly selective schools. They and their students commonly discount claims from some institutions that calculus is not required. Skeptics point to the large proportion of selective college admits who have taken the course. However, admissions officials at some universities counter that students' coursetaking behavior, not colleges' practices, dictates those numbers. Most students seeking competitive admission take large numbers of advanced courses, including calculus, they say.

Increasingly, colleges expect courses beyond introductory calculus, counselors say. Expectations that students take the most rigorous or most advanced courses available at their schools have contributed to the continual redefinition of rigor. While an introductory calculus course may have been sufficient in the past, participating counselors increasingly assume that, to be competitive at the most selective institutions, students must successfully complete AP Calculus BC, which fewer than a third of high schools offer. Some ambitious high schools offer higher-level courses such as Multivariable Calculus, Linear Algebra, Differential Equations, and even Knot Theory. These patterns

contribute to an arms-race mentality.

Many counselors value statistics courses but say admissions offices don't. Counselors overwhelmingly value statistics preparation, but only 5 percent of survey respondents said they recommend statistics equally with calculus for admissions purposes. Rapid expansion of data and access to technology have made statistics classes increasingly relevant and changed the way they are taught. About one in six high school students takes a class in statistics, and statistics was mentioned by survey respondents more than any other non-calculus path course. But among students applying to selective colleges, the shift toward statistics has been slow. For students applying to selective colleges, counselors often recommend statistics or AP Statistics only to those students who struggled in precalculus.

Most counselors believe calculus is not necessary for all students, yet many say pressure to accelerate



to calculus is excessive. “Math unfortunately seems to rule our building,” said one high school counselor. Counselors tended to blame colleges for pushing calculus, saying that colleges don’t defend or explain the preference. Many urged colleges to broaden their expectations and increase transparency. Some argued that expectations should align with curricular needs in students’ intended areas of study, meaning that statistics or other options would be valued for students pursuing social sciences and humanities, for example.

TIME FOR CHANGE

For real change to happen, education leaders, policymakers, and professional organizations must update policies and ensure transparency. Here are some recommended next steps:

FOR COLLEGES AND UNIVERSITIES:

Adopt clear admissions policies and specific guidelines about math expectations for various schools and majors. In collaboration with faculty, admissions offices should reconsider how they weigh various math courses on students’ transcripts in alignment with students’ college goals.

Implement the policies consistently. Counselors, teachers, and families won’t trust that policies have changed unless they see them translated into practice.

Commit to transparency. Admissions offices can also take the lead on enhancing transparency around expectations. Instead of opaque advice to “maximize what’s available,” colleges can communicate that students should, for example, have x years of progressively advanced math aligned with their academic interests.

Develop shared resources. Colleges, math associations, and professional organizations can create shared materials with up-to-date information and infographics on alignment of math sequences with various majors and careers to support conversations about refining admissions criteria.



FOR STATE EDUCATION DEPARTMENTS, SCHOOL DISTRICTS, HIGH SCHOOLS, AND MIDDLE SCHOOLS:

Expand math offerings to include rigorous and relevant options aligned with college majors and careers. For example, students seeking to pursue most STEM majors would focus on the pathway to calculus, while students with an interest in the social sciences could pursue statistics and/or data science courses.

Articulate college counseling with academic counseling as early as the transition to middle school. This would raise awareness of majors and careers to support students’ choices and ensure that no students are placed into dead-end sequences or prematurely tracked out of STEM opportunities.

Attend to students’ mental health and well-being. High schools can consider ways of minimizing the emphasis on acceleration, such as setting limits on the number of AP courses offered or the number students are allowed to take. Those providing multiple levels of advanced mathematics can reconsider the need for those offerings, while also ensuring more equitable access to those courses they continue to offer.

"Slowing down the math progression and really learning it is way better than accelerating, but I think there is a disconnect. When I worked in admissions, we definitely dinged kids who didn't have calculus on their transcript."

– high school counselor

CALCULATING THE ODDS:

Counselor Views on Math Coursetaking and College Admissions

“It is deeply problematic that college admission offices—many of which are entirely unaware of how actual math content, sequencing, programs work—use calculus as a benchmark for college admission. It’s one of the most frustrating things about the process.”

– high school counselor

Calculus is the study of change—continuous, infinitesimal change. It is a key to measuring phenomena as diverse as epidemics, acoustics, and planetary motion. But since calculus was catapulted to the top of the academic heap more than 50 years ago, little has changed in terms of the course’s standing. Its preeminence as a hallmark of intelligence and academic rigor has hung on as stubbornly as its syllabus. Selective colleges use it as a gatekeeper, and high school students scramble to take the course and succeed.

Math education leaders have challenged these patterns for years (Bressoud, 2017; 2020a). While students pursuing physics, engineering, and other technical majors undoubtedly need to study calculus in either high school or college, the majority of students do not major in STEM (science, technology, engineering, and mathematics) fields. Using completion of calculus to classify applicants as college worthy carries serious consequences:

- For many students, the forced march through mathematics **interferes with development of foundational math skills**.
- Differential access to advanced math in high school means that prioritizing calculus **exacerbates educational inequities** along race and class lines.

- The practice **exerts enormous pressure** on students seeking to demonstrate their merit to competitive colleges.

The prioritization of calculus also reflects a “reputational model” of higher education with a “fundamental preoccupation with exclusivity” at the expense of equity (NACAC/NASFAA, 2022). This attitude toward mathematics achievement is also tainted by stereotypes about academic ability. Presumptions of brilliance, particularly prevalent in fields such as math and physics, often align with race and gender (Jaxon et al., 2019; Leslie et al., 2015). High school students, their families, and their counselors are at the mercy of this model, with students already marginalized by the education system facing the starkest odds, potentially derailed from the optimal pathway by the time they reach middle school.

The goal of this report is to shed light on how counselors view the persistent attachment to calculus in college admissions. The report is the second in a series examining how—and why—preferences for calculus affect college opportunity. The first report, [A New Calculus for College Admission—How Policy, Practice, and Perceptions of High School Math Education Limit Equitable Access to College](#), released in January 2022, centered on the preferences of admissions officers at selective colleges and

METHODOLOGY

For this report, Just Equations partnered with the National Association for College Admission Counseling to examine counselors' perspectives on high school students' math coursetaking options in the context of college admissions. The goal was to shed light on how counselors advise students about math course enrollment and college applications.

Two surveys were used to gather this information. The first was sent to 1,967 high school counselors across the country. Among the 323 responses, 232 came from counselors at private high schools and 67 from counselors at public high schools. The remainder were from charter or other schools.

A second, similar survey was sent to independent counselors—consultants or advisors who are hired by families to support students with their college applications. Of the 605 individuals who were sent the survey, 70 responded. The two surveys asked many of the same questions that we asked admissions officers for the prior report, about beliefs and preferences concerning advanced math. They also asked counselors how they advised college-bound students and their families about math coursetaking.

We also conducted in-depth interviews with counselors at public and private high schools focused on competitive college admissions, as well as with independent counselors. There were 14 interviews in all, spanning multiple states, including California. These discussions provided a deeper understanding of admissions policies and practices that inform participants' advice to students about advanced math coursetaking in high school.

Unless otherwise noted, all quotations in the report come from either the survey responses or the interviews. Because some participants did not wish to have their names or affiliations disclosed, we have treated all responses as anonymous, identifying only the individual's role and/or the type of institution. Mentions of specific higher education institutions by name refer to publicly available information.



The report also references our prior report's findings on admissions policies, practices, and perceptions based on 137 responses to a survey of admissions officers at four-year colleges and universities.

The respondents to the current survey are not representative of all high schools in the country. High school counselors who belong to NACAC and respond to surveys likely represent schools with a strong college-going culture and an interest in competitive college admissions. The survey responses demonstrate this. For example, 88 percent of respondents said their high school offers Advanced Placement Calculus, whereas only 53 percent of high schools nationally offer AP Calculus, though those schools enroll 82 percent of students nationally (Hayes, 2019, p. 18, Table 23).

Response rates also differed among categories of counselors. The 19-percent response rate for private high school counselors was more than double that of their public counterparts, at 9 percent. This may reflect differences in resources, the emphasis private schools place on competitive college admissions, and the nature of counseling at private high schools, which are roughly twice as likely as public high schools to have counselors dedicated to college advising (Radford et al., 2016, Figure 3; Clinedinst & Patel, 2018, p. 4). The response rate for independent counselors was 12 percent.

universities. It revealed that, though colleges rarely require calculus for incoming students, many selective colleges implicitly expect students to have the course on their transcripts, putting a high-stakes complexion on students' math enrollment decisions. More than two-thirds of admissions officers told us that students who take calculus in high school are more likely to succeed in college, for example.

As that report noted, signals sent by elite colleges influence the entire admissions landscape, affecting the practices and perceptions of colleges that admit the majority of applicants. Selective colleges, generally defined as those accepting fewer than 50 percent of applicants, account for less than a quarter of undergraduate enrollments (Clinedinst & Patel, 2018, Table 2). These prestigious, name-brand institutions attract disproportionate attention, not just from other colleges, but also from many with direct ties to students—parents, teachers, and counselors. Admissions officers note that often these individuals encourage students to take calculus, based on their impressions of elite school admissions, even when colleges themselves do not. The influence of counselors, in particular, can be powerful.

Counselors are intermediaries. They help students make plans and decisions as they navigate the admissions process, but they don't write the rules. For counselors at college prep-oriented high schools, balancing students' personal development and wellness may compete with providing guidance around math coursetaking. Students attending less well-resourced schools are often at an automatic disadvantage in terms of access to advanced courses and availability of counseling for college preparation. A disproportionate—and sometimes covert—emphasis

on calculus compounds inequities experienced by groups that have historically been excluded from selective colleges and STEM fields, particularly Black, Latinx, and Indigenous students.

This report examines how high school counselors interpret admissions offices' expectations, driving their advice that students maximize calculus opportunities. The conclusions are based on a survey and interviews conducted in partnership with the National Association for College Admission Counseling (NACAC). In addition to considering how to align students' math courses with their aspirations, it explores ways of supporting equitable access to advanced math courses and alleviating the academic pressure experienced by many students.

HIGH SCHOOL MATH: THE COUNSELING CONTEXT

We know that it is not developmentally appropriate for students to race to calculus. Unfortunately, it also seems that students who do not get to calculus are disadvantaged during the admissions process. The college counseling office and math department are in constant communication about how to both meet the developmental needs of students and ensure they are competitive applicants. It is a very difficult balance.
— high school counselor

Like most educational resources, support for college preparation is not evenly distributed. Calculus is not universally available, with students experiencing poverty and Black, Latinx, and Indigenous students facing the longest odds of taking the course. Even at schools that offer calculus, placement practices and scheduling constraints can limit access. As long as calculus remains valued in college admission, students without access to it can face a liability in the college application process.

In 2019, 16 percent of high school grads—roughly half a million students—had calculus on their transcripts. But the course was taken by 46 percent of Asian American students and 18 percent of White students versus just 6 percent of Black students and 9 percent of Latinx students. Students from the highest-income quartile of high schools were almost three times as



PERSPECTIVES FROM THE MATH COMMUNITY

Leading math educators and math associations have endeavored for decades, through statements and recommendations, to dislodge calculus from its lofty perch in high school coursework and college admissions. These efforts have several themes.

Some focus on the **dangers of accelerating students too rapidly** in order to reach calculus in high school. “Mathematics learning is not a race, and evidence suggests that students who speed through content without developing deep understanding are the very ones who tend to drop out of mathematics when they have the chance,” wrote the National Council of Teachers of Mathematics (NCTM) in 2018. Privileging calculus in the admissions process can place undue pressure on students and teachers to rush through the math curriculum to reach calculus by 11th or 12th grade, compromising learning for many (Bressoud, 2020a).

A second imperative has been to **expand math learning opportunities beyond calculus** and its prerequisites. While calculus is a steppingstone for STEM, STEM degrees make up just 18 percent of bachelor’s degrees (National Center for Education Statistics, 2019, Figure 26.1). “There is a call to provide mathematically substantive options for students who are not headed to calculus,” according to a joint statement from five leading mathematics societies. “We acknowledge the need to focus on the calculus sequence and ensure that pathways to it remain a high priority ... but it behooves us to develop curricula effective for the majority of the population as well.” (Saxe & Braddy, 2015).

Math requirements vary by institution and region, but degrees in social science fields such as psychology, political science, and criminal justice often require statistics. Arts and humanities majors may benefit from courses in quantitative reasoning or mathematical modeling (Burdman et al., 2018). Admissions offices’ real or perceived preferences for calculus compel a subset of students to make inauthentic choices—forgoing classes that may interest them to study topics they may never use—simply to get admitted to preferred colleges. Such practices can likewise inhibit high

schools from providing new rigorous math options, such as statistics, data science, and mathematical modeling, even though many teachers and counselors are eager to offer more engaging and relevant courses.

“The ultimate goal of the K–12 mathematics curriculum should not be to get students into and through a course in calculus by 12th grade but to have established the mathematical foundation that will enable students to pursue whatever course of study interests them when they get to college,” noted NCTM and the Mathematical Association of America in a 2012 statement.¹

Lastly, another critique focuses on the **need to update calculus sequences** to heighten cognitive demand and better align with disciplines that utilize advanced math (Burdman, 2022; Shaughnessy, 2011). J. Michael Shaughnessy, a former NCTM president, calls the sequence “an out-of-date, wasteful, and repetitive transition path [that] does nothing to improve our students’ disposition toward mathematics.” Even a former faculty consultant for AP Calculus has called the course “short on the kinds of contextual problems needed to develop quantitative literacy” (Madison, 2003, p. 159). A 2016 study concluded that college calculus exams “require low levels of cognitive demand” (Tallman et al., 2016).

Such stances haven’t dislodged calculus’ position on the academic map as a go-to course for students eyeing the most selective colleges, including private institutions and some state flagships. But several states have been expanding high school math options, including those working with the Launch Years Initiative, led by the University of Texas at Austin (Charles A. Dana Center, 2020).

Ohio has adopted new courses, such as Data Science Foundations, Discrete Math, and Quantitative Reasoning, while its public universities are adapting [admission requirements](#) in response. In California, a proposed [math framework](#) acknowledges the need for non-calculus options—though its cautions against acceleration were met with such fierce opposition that writers had to clarify that schools still had the option to begin the high school math pathway in middle school.

¹ As this report was going to press, NCTM and MAA issued an updated statement. It can be found here: <https://www.nctm.org/Standards-and-Positions/Position-Statements/Calculus>.

likely to take the course as students from the bottom half of high schools by income. And those with no disabilities were four times as likely to take calculus as those with disabilities. (National Center for Education Statistics, 2022, figures 2, 3, and 5).

Scant availability of counseling for college planning at some high schools contributes to these barriers, especially for students and families who are not in the know about college expectations. The problem begins as early as middle school, because few high schools have pathways to calculus for students who didn't take Algebra I in middle school.²



The surveys and interviews informing this report underscore this inequitable dynamic by highlighting the support and guidance about math course selection available to students at schools that do emphasize college planning. Rather than represent a cross section of all high schools nationally (see *Methodology*, p. 9), our survey focuses on the practices and perceptions of counselors at college prep-oriented high schools, in order to shed light on the dynamics driving college-bound students' math course decisions.

These high schools and their counselors and students collectively help shape the competition for spots at in-demand colleges, which respondents tended to refer to as “selective” or “elite” institutions.³ The most highly selective institutions—which admit fewer than

10 percent of applicants—enroll only about 4 percent of students attending four-year institutions (DeSilver, 2019). Yet, they influence the entire ecosystem of college opportunity, even for students seeking to attend less-selective colleges.

Private high schools devote comparatively more resources to helping students with college selection and application. They are twice as likely as public schools to have counselors dedicated to college advising (Clinedinst & Patel, 2018, p. 4). U.S. public schools serve an average of 470 students per counselor, nearly double the ratio recommended by the American School Counselor Association (Patel & Clinedinst, 2019, p. ii).

The average obscures the range, however. Public schools in higher-income communities are able to offer more college counseling services than those in lower-income communities (Radford et al., 2016). Nearly one in five students, or about 8 million students, lack access to basic counseling support at school, including 1.7 million who attend a school with a police officer but no counselor (Patel & Clinedinst, 2019, p. ii).

Differences in high school graduation requirements are instructive. Counselors participating in our survey overwhelmingly recommend that students intending to go to college take four years of high school math, particularly if they seek admission to selective institutions. Though most colleges require three years of math, more than a third ask for four years, many of them selective institutions (Anderson & Burdman, 2022).

Most high schools do not require four years of math. In our survey, public high school counselors were the least likely to say their schools have a math requirement aligned with college admissions recommendations. Just 32 percent of public high school counselors said their schools required four years of math to graduate, compared with 50 percent of their private school counterparts.

That is consistent with state policies. A majority of states (27) require three years of math to complete high

² Some districts, notably San Francisco Unified School District, have begun to offer options to accelerate during high school, while discouraging or forbidding middle school acceleration. This approach has some support from the math education community, but it remains controversial and has not been independently evaluated.

³ Respondents used a variety of definitions for selective institutions. Generally, “selective” meant colleges admitting fewer than 50 percent of applicants, and “highly selective” referred to those admitting fewer than 30 percent of applicants, and sometimes fewer than 10 or 20 percent.

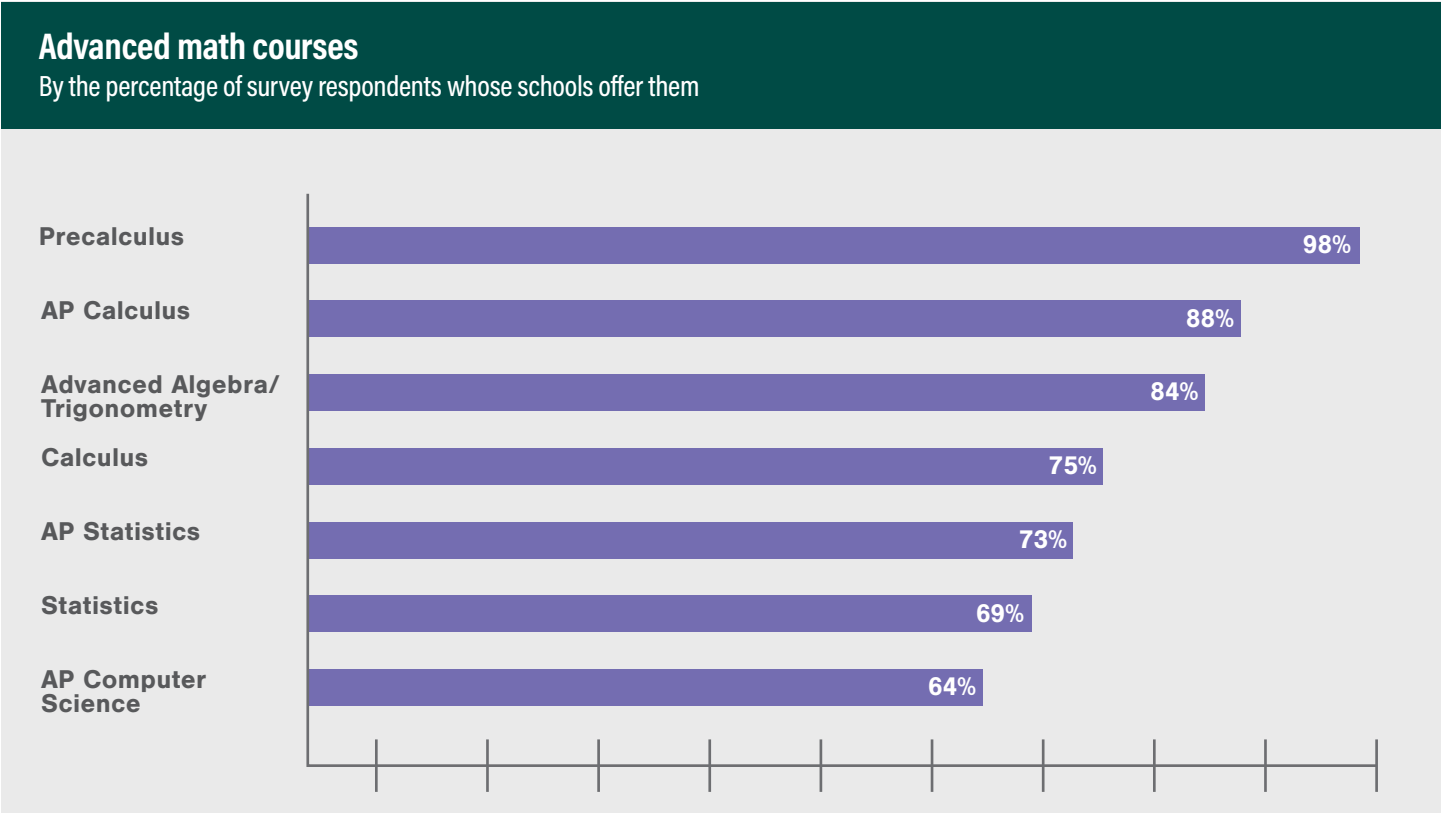
school. Another 17, including Massachusetts, Ohio, New Mexico, and many Southern states, require four years (Gao, 2017; Charles A. Dana Center et al., 2022). In the absence of requirements, many students don't automatically take math for four years (Charles A. Dana Center et al., 2022), making counselor recommendations key to students' coursetaking decisions. Likewise, many parents of middle schoolers may not realize the stakes associated with students' math placements.

Colleges' lack of transparency about their expectations compounds the difficulty for some students, particularly those at schools where course selection and college counseling are not connected. Noted one independent counselor in a survey response, "A lot of students out there are disadvantaged by colleges not being more clear about what will or will not hurt their application chances when it comes to math course selection and level of rigor."

In addition, wealthier families may hire independent college counselors to provide more tailored support for their students, often with an eye toward ensuring acceptance to more selective institutions. While school-based counselors are trained in comprehensive counseling, including addressing students' social-emotional needs, independent



counselors generally serve a clientele with a willingness to pay thousands of dollars, beginning as early as the eighth or ninth grade, and an interest in highly selective colleges. These families typically are able to fully fund their children's college education. Many are highly focused on ensuring their kids take numerous AP courses, for which high schools and colleges often assign extra weight in students' grade-point averages, interviewees noted. Some independent counselors have backgrounds as admissions officers, counselors, or teachers, but the majority come from outside of education (Sklarow, 2018).



DEFAULT RECOMMENDATION

College admissions is not objective. It's a very subjective process. The more highly selective, the less transparent they are. They keep everyone guessing because they can.

— independent college counselor

Respondents valued calculus nearly universally for college admission, particularly for students applying to selective institutions, despite not believing that calculus is academically necessary for all students. Some specifically faulted colleges for placing undue weight on advanced math courses, even for students with interests in the arts and humanities. But as they calculate the odds of admission to selective colleges, most felt they had to eschew their skepticism. Most advise students with such colleges in their sights to take at least one calculus course, ideally an AP course, a sentiment exemplified by this comment from a high school counselor:

The true educational value of calculus may well be vastly overrated, at least for students who aren't pursuing rigorous STEM majors like engineering or computer science. [Yet] for students seeking entry to selective and highly selective colleges, taking calculus in high school is very important, and not advising them accordingly is irresponsible.

Counselors' overwhelming agreement that calculus raises students' college prospects contrasts with admissions officers' views. In our prior study, only 53 percent of admissions officers said calculus gives students an edge in admissions, compared with 93 percent of high school counselors and 97 percent of independent counselors. Furthermore, counselors' recommendations to take calculus were weighted toward admissions strategies rather than learning. Private and independent counselors were most likely to value calculus in the admissions process and less likely to affirm its contribution to college success, as compared with public school counselors and admissions officers. (See *Contrasting perceptions*, p. 17)



These patterns may reflect the profiles and college ambitions of the students these counselors work with. Students at private schools are 60 percent more likely to take a calculus course than students at public schools (National Center for Education Statistics, 2022, Figure 4). Independent counselors were particularly likely to emphasize calculus, our survey suggested. “I urge all my students to take as high a level of math as they are able to, with a minimum of four years, but many ending up with six to seven years,” said one survey participant, noting the trend of students starting high school math courses during middle school.

The pro-calculus message appears strongest for students seeking to attend highly selective colleges or major in STEM. Very few high schools have a majority of students on track to take calculus by their senior year. Typically, reaching calculus requires starting Algebra I during middle school, and only some schools make that option available. About a quarter of students start the sequence in middle school, according to a recent analysis (Charles A. Dana Center et al., 2022). In our survey, about a quarter of counselors said half or more of their students complete AP Calculus.⁴ At the same time, 8 percent of respondents' schools don't offer AP Calculus, and 26 percent have no non-AP calculus option.

⁴ A similar proportion said half or more complete Calculus in general, but because of the way the data was collected, we cannot determine whether there is overlap between the categories (either students taking two different calculus courses, or counselors including AP Calculus in their responses about calculus.)

Most high schools responding to the survey offer AP Calculus. (See *Advanced math courses*, p. 13) Private schools were somewhat less likely than public schools to offer the course, but in some cases that is because the schools offer their own advanced course, as some private school counselors told us:

We moved away from AP but still offer the rigor in-house.

We do not offer any AP-designated courses. But the syllabi for our calculus and statistics courses prepare students for the AP exams.

For many respondents, especially for independent counselors, calculus was seen as a default for those students who do have the option, because they are on an accelerated path. Only 10 percent of high school counselors in the survey said that most or all of their students take AP Calculus by their senior year, and another 17 percent said around half of their students do so. (This data was not broken down by type of school, but the corresponding figure for independent counselors was far higher: Nearly four times as many, about 39 percent of independent counselors, said most of their clients took AP Calculus. Another 35 percent said about half of their clients take the class.)

The top reason respondents recommend calculus is to ensure that students are competitive for the colleges they want to attend, especially those pursuing majors that require calculus. They mentioned STEM majors most frequently, followed by business.

I recommend they take the most challenging course they can where they will be successful. If a student is considering a college major of engineering, physics, computer science, and other areas of STEM, we encourage calculus.

Potential engineers, STEM [professionals], and architects are encouraged to at least complete calculus if not more.

I tell students in order to be competitive for admission at the most selective colleges—especially if they are interested in business or engineering programs—they will position themselves best if they take calculus.

Even for students with aspirations in other areas, many counselors still advise students that having calculus on their transcripts increases their odds of admission to selective colleges.

In general, we will counsel families that completing calculus before graduation is an extremely important hurdle to clear for the most selective colleges in the country.

Even if calculus isn't important in the long run (because a student is, say, an English major), admission officers have said that it's a necessity for admission today at most selective schools.

Kids who were applying to highly selective colleges all took calculus; some of them succeeded in getting in and others not. In other words, calculus seems a prerequisite for serious consideration at a very selective college but not a guarantee of admission.

In order to be competitive in our local community, top students need to be on track to take AP Calculus as seniors. Some take it as juniors and then take AP Statistics as seniors. Precalculus is the lowest level math I typically have among my seniors.



Though counselors often based their recommendation to take calculus on admissions office expectations, a few focused more on the course's educational benefits, believing that taking calculus in high school would give students a leg up on college calculus. The presumption was often that students would take calculus again in college, and very few mentioned placing out of Calculus I or II. Here are some responses as to whether they recommend calculus, and why:

Absolutely. If they back off in math before they graduate they will drown in their first year of college. Those students with calculus seem more confident and ready to study in college.

I look at how our students struggle with the abstract thinking required in calculus. ... I cannot imagine tackling those subjects for the first time in college. The pace alone as they work to master this content could be crushing. I'd rather they test this content out and get an understanding of calculus before they reach college.

Having a foundation in calculus will also help those students when they enroll and have to take Calc I and Calc II at the collegiate level.

According to David Bressoud, former director of the Conference Board of the Mathematical Sciences, this “self-reinforcing dynamic” dates back to the 1990s. “Word got back to the high schools that students who had not seen calculus before they arrived at university were competing against those who had already passed the course in high school,” he noted, citing two surveys of students. “The perception continued to grow that one faced a severe disadvantage in college calculus if it had not been taken in high school” (Bressoud, 2020a, p. 523).

By 2010, roughly two-thirds of students enrolled in Calculus I had taken the course previously, and the proportion may be higher now (Bressoud, 2020b). Bressoud and other mathematics leaders have voiced concern about this pattern. More than 60 percent of students who take a calculus course in high school either take the course again when they get to college or enroll in a calculus prerequisite course. Another 18 percent take a statistics course or another math course that doesn't require them to know calculus (Bressoud, 2017, p. 5). Calculus prerequisites have been shown

to better prepare students for college calculus than a high school calculus course (Sadler & Sonnert, 2018). Despite research showing that rushing to calculus ill serves many students, those who have not previously taken calculus can feel intimidated in a college class with others who have, especially when top letter grades are rationed (Burdman et al., 2021).

OVERT AND COVERT EXPECTATIONS

Few colleges treat calculus as a blanket requirement, unless there is an institutionwide focus on STEM majors, as is the case at CalTech and MIT (Anderson & Burdman, 2022). Stanford stopped requiring calculus for incoming freshmen four years ago. Nevertheless, based on their own experiences, many counselors have concluded that the course is at least strongly expected at more-selective schools, regardless of students' interests and despite what colleges publicly say.

I had one admissions officer at a highly selective college tell me they had only admitted one student in the past three years without calc and advised my student (first gen, single parent, who had many other advanced courses, and was homecoming queen and the center of our student life) apply elsewhere. Calculus, especially BC Calc (and beyond for the most highly selective) is a must. It's not even worthy of conversation anymore. And this has been true the past 10-plus years at the high schools I've worked.

I have found that the most selective colleges—and even medium-selective colleges—look for calculus even if the student's intended major does not require calculus.

We've been told that colleges prefer calculus in their curriculum. Some have told us at least BC Calculus or higher.

From my time working at a highly selective college, and from what I hear from colleges, I believe that calculus is viewed as a gatekeeper course by many colleges. I don't believe this should be the case, based on research and student outcomes, but I don't want to disadvantage my students by advising them otherwise.

We are aware of schools that see calculus as pay-to-play, even if students' intended major is philosophy.

CONTRASTING PERCEPTIONS ON MATH AND COLLEGE ADMISSIONS

Across all three surveys (high school counselors, independent counselors, and admissions officers), taking calculus in high school was seen as valuable for college-bound students. But the emphasis on calculus varied by role. Counselors tended to think calculus provides an edge in the admissions process, while far fewer college admissions officers held this view. Counselors were also far more likely than admissions officers to say that students' college options would be narrowed if they didn't take calculus in high school.



NOTE: Percentages indicate the proportions of each group who reported that they either “agree” or “somewhat agree” with the corresponding statement. The same language was used on each survey, with the exception of two variations on the admissions officer survey. On the third statement, the percentage indicates the proportion of admissions officers who responded “yes” or “in some cases” to the question, “Does calculus give applicants an edge in the admissions process?” For admissions officers, the fourth statement read, “My institution’s faculty place a high priority on calculus for demonstrating a rigorous math curriculum.”



(in practice even if it is not what some have said in interviews) that that is what they want.

For students applying to the most highly selective colleges, calculus is still covertly expected.

This lack of transparency, not to mention consistency, among colleges makes erring on the side of calculus to be more typical.

We have had students not admitted into competitive business and engineering programs because they did not have AP Calculus.

At my previous school, it was abundantly clear that students who completed calculus by their senior year were advantaged in the admission process, especially by colleges with a 20-percent admit rate or lower. Also, in most every instance, students who did not take calculus were shut out of engineering programs.

Counselors and students commonly discount claims from some institutions that calculus is not required. For example, six years ago, the University of California's admissions board released a statement discouraging students from racing to calculus and clarifying that the course was not required for admissions. Experienced counselors, including some who were interviewed for this report, remained skeptical.

"They tend to say without saying it that these are the kinds of courses they'd like to see our students have," noted one California private school counselor who was interviewed. In particular, when colleges say that students should take the most advanced or most rigorous courses available to them, the default assumption is that they are looking for calculus, said the counselor, whose school doesn't plan to change their advice to students until they can observe a change in admission patterns.

Others were similarly doubtful about the notion that colleges do not place a priority on calculus:

Selective college admissions have made it clear

Disbelief also surfaced on social media when it recently came to light that Harvard's admissions office explicitly notes that calculus is not a requirement or a preference (See *Clear statements*, p. 19) Skeptics shared [this](#) Harvard Crimson profile of the Class of 2023, showing that more than 35 percent had taken BC Calculus, and just over 20 percent had completed multivariable calculus. The 7 percent of students who had not taken any sort of calculus course were considered the exception that proves the rule.

In California, doubters point to the large proportion of UC admits⁶ who have taken the course. However, admissions officials at UC and some other selective universities counter that—despite perceptions that the emphasis on calculus is coming from colleges—students' coursetaking behavior virtually dictates that large proportions of admits will have calculus on their transcripts. Most students seeking competitive admission take large numbers of advanced courses, including calculus, they say (Anderson & Burdman, 2022). Some admissions professionals have said that their concern about this pattern is leading them to be more vocal about not expecting calculus, at least outside of majors that explicitly require it.

⁶ Interviewees and respondents spoke from personal observations. From Asim & Kurlaender (2018), we know that 65 percent of UC admits have taken an AP math course. While that study did not break out the proportion taking AP Calculus, it is clear from other analyses that AP Calculus enrollments far exceed those in AP Statistics.

IS MULTIVARIABLE CALCULUS THE NEW AP CALCULUS?

Expectations that students take the **most rigorous or most advanced courses** available at their schools have contributed to the continual redefinition of rigor. While an introductory calculus course may have been sufficient in the past, participating counselors increasingly assume that, to be competitive at the most selective institutions, students must successfully complete AP Calculus BC, which fewer than a third of high schools offer (Hayes, 2019, Table 4.14).

What's more, though the College Board initially intended students to take *either* Calculus AB (the

equivalent of Calculus I) or BC (the equivalent of Calculus I and II), it has become common for students to take both, thereby notching two AP courses instead of one. Even though there is significant overlap between the courses, some schools even require students to take AB before BC. Such highly advanced offerings may cater to the needs of individual students, but the trend appears to be intensified by the contention for college spots.

College Board data shows that, in 2021, almost 130 students below ninth grade took the AP Calculus AB exam, and a similar number took the BC exam. At one private boarding school, there are freshmen taking the equivalent of AP Calculus BC, and some sophomores enrolling in linear algebra and multivariable calculus, according to an interview. By senior year, such

CLEAR STATEMENTS: CALCULUS \neq ADMISSIONS REQUIREMENT

In 2016, the University of California system issued a [statement](#) cautioning students against racing to calculus at the expense of mastering more foundational math content:

No single course, including calculus, determines an admissions decision. ... Students who go beyond the minimum math requirement should not view calculus as the only option. Other possibilities include discrete math, math analysis, precalculus, and statistics, with the best choice depending on a student's interests and preparation.

Stanford, in 2018, removed mention of a calculus expectation from its admissions website. The current language emphasizes four years of "rigorous mathematics," noting that statistics and calculus are welcome as additional preparation.

Harvard University is among highly selective universities that have recently become more vocal about not expecting all admits to have calculus on their high school transcripts. Its [description](#) reads, in part:

Applicants to Harvard should excel in a challenging high school math sequence corresponding to their educational interests and

aspirations. Rigorous and relevant data science, computer science, statistics, mathematical modeling, calculus, and other advanced math classes are given equal consideration in the application process.

Specifically, calculus is neither a requirement nor a preference for admission to Harvard. We understand that many students have no intention to pursue college coursework that requires a knowledge of calculus, and that other students are unsure of their future college studies. We also understand that not all students have the same opportunities to take certain math classes in high school, including calculus. Thus, we encourage applicants to pursue the pathways through math that are available to them and aligned with their interests and goals.

Students intending to study engineering, computer science, physics, or other fields for which a knowledge of calculus is required may benefit from taking calculus in high school. However, applicants who have not taken calculus in high school can still pursue such fields of study here by starting with one of Harvard's introductory calculus classes that has no high school calculus prerequisite.

students are positioned to take an independent study in topics such as algebraic topology. “Students who have calculus, differential equations and multivariable calc are more commonly admitted to the most highly selective universities. This is a pattern I have seen since 1998,” noted one independent counselor.

The problems with this pattern begin with **confusion over the meaning of rigor in mathematics**. The education nonprofit Student Achievement Partners defines rigor as “deep, authentic command of mathematical concepts, not making math harder or introducing topics at earlier grades,” adding that rigor combines conceptual understanding, procedural fluency, and application of math concepts (Burdman, 2021). Contrast that with one counselor’s understanding of rigor:

I recommend that all students have calculus. I want my students to have as much rigor as possible, and since math beyond AP Calculus BC is available at the high schools my students attend, merely taking calculus is not that much rigor.

Blaire Moody Rideout, director of admissions at the University of Michigan Ross School of Business, questioned this approach during a 2022 Just Equations conference presentation. “There is certainly an institutional viewpoint that calculus equates to rigor,” she noted. “Rigor has become more of a rigor check. It’s very coded language for stratifying the system.” For this reason, the Ross School is seeking to modify its approach.

Another problem is that advising students to take the “most rigorous” courses can create perverse incentives for high schools with elite college ambitions to ratchet up the number of advanced math courses. While accelerating students into Algebra I during eighth grade is not uncommon (Loveless, 2013), many math education experts discourage hyperacceleration, pursued by roughly one-eighth of college-going students, who take Algebra I in seventh grade or even earlier. The pattern highlights a tension between “broadening access” and “identifying the elite students of the future,” according to a recent study of the phenomenon (Galanti et al., 2021). Early acceleration can interfere with students gaining deep understanding and command of algebra while amplifying inequities in high school mathematics, the authors note.

Despite such cautions, more than a handful of high school-based counselors participating in the survey said their schools offer multiple courses beyond AP Calculus BC.

We do not offer AP courses but go well beyond the AP curriculum with Multivariable Calculus, Linear Algebra, Differential Equations, Knot Theory, Number Theory, Graph Theory.

We do not offer an AP curriculum. We teach our own Accelerated Calculus, Multivariable Calculus, Linear Algebra, Game Theory, Collaborative Problem-solving, two levels of advanced computer science.

This is an ongoing battle. Colleges send very strong messages that students should maximize the curriculum that is available, and, because we offer AP Calc AB and BC as well as Calc II and Calc III as dual-enrollment courses, many students feel they will not be competitive at the more selective schools unless they take these courses.



When reviewing applications, college admissions officers often look at school course lists to assess the availability of challenging courses. This relatively common practice exerts pressure particularly on students who attend schools that offer more advanced courses. The burden is on them to demonstrate that they are challenging themselves by taking as many of these courses as possible. The abundance of such courses at certain high schools may have the unintended effect of intensifying competition among students at those schools. It may also privilege such students compared with those attending schools with

fewer academic offerings, especially if colleges don't view students' math coursetaking in context, as one respondent noted:

In a recent college info session with a highly selective university, I was told that 100 percent of admitted students in their engineering program had taken advanced calculus (above BC). This was disheartening, as this is not a course we offer or are able to offer. If we have a student who would like to take this course, they must pursue it on their own and pay for it.

But even counselors who disagree with the trend say they are hard-pressed to stop it. "It's like an arms race for taking the higher-level courses, and the more everybody takes, the more everybody else takes. Then it's like, they've already taken BC Calc, so that's when they move on to the stuff that's multivariable, and take it at Stanford online or Foothill College or wherever." The result reinforces an already uneven playing field. In college, calculus courses serve students seeing the content for the first time as well as those who took it during high school (Bressoud, 2020a).

HOW STATISTICS STACKS UP

Over the years, statistics has gained traction as a high school course offering. Rapid expansion of data and access to technology have made the course increasingly relevant and changed the way it is taught. Thirty years ago, just 1 percent of high school students took a statistics course. Now, approximately one in six students does (National Center for Education Statistics, 2022, Figure 1). AP Statistics was mentioned more frequently in survey responses than any other non-calculus pathway course (for other examples, see *Nontraditional options*, p. 24) But in the competition for prestigious college spots, it hasn't replaced calculus.

Most counselors surveyed found statistics to be highly valuable preparation, but less rigorous and less valued by colleges than calculus. Private school counselors are more likely to say calculus carries more weight in college admissions than statistics, while independent counselors are more likely to believe statistics is not as tough as calculus (see *Counselor views on statistics*, p. 22). This suggests a demand ceiling for statistics at high schools where students and their families are

DUAL ENROLLMENT FOR ACCELERATION AND ADMISSION?

Some high schools allow their students to take college-level courses via dual enrollment, also known as dual credit. While students can pursue such arrangements at their own expense, in California and other states, school districts and colleges are forming partnerships to provide free access to college courses. Such programs are considered strategies to expand college access to underserved populations, though research has shown that they don't always achieve this goal (Kurlaender et al., 2021).

Some of these partnerships provide students with access to advanced math courses, often courses beyond calculus. Some dual enrollment programs offer college courses at nearby high schools; others require students to travel to the college campus or take courses online. Most respondents whose schools did not offer advanced options said their schools facilitated access to college courses via dual enrollment.

"We definitely have students who exhaust our line so we provide opportunities for them at the local community college," noted one California public high school counselor in an interview. "We also have a good number of students who like to take math coursework in the summer, generally free opportunities through the community college. We don't want them having to deal with AP exam fees. And we want transferable credit and an authentic college experience."

As some public middle schools are deemphasizing math acceleration, some students are also turning to community colleges to provide a fast track to calculus by junior or senior year.

focused on selective college admissions. For students applying to selective colleges, counselors often recommend statistics or AP Statistics only to those students who struggled in precalculus, especially if the course grade will appear on their transcripts.

I recommend students applying to selective or highly selective colleges take AP Calculus, because I've come to understand that college admissions reps value that class more than AP Stats.

I don't think that stats or data science are less important, only that the most selective schools (including ... our state flagship) expect these high-level calc courses for admission, irrespective of students' academic interests, and AP Stats rarely fills that bill at schools with admit rates of under 20 percent.

If they are leaning humanities and applying to an elite school, AP Stats is an option, but I am wary, since my perception is that calc is almost a given for an applicant at a highly rejective school.

Some schools consider AP Statistics to be a social science and not math.

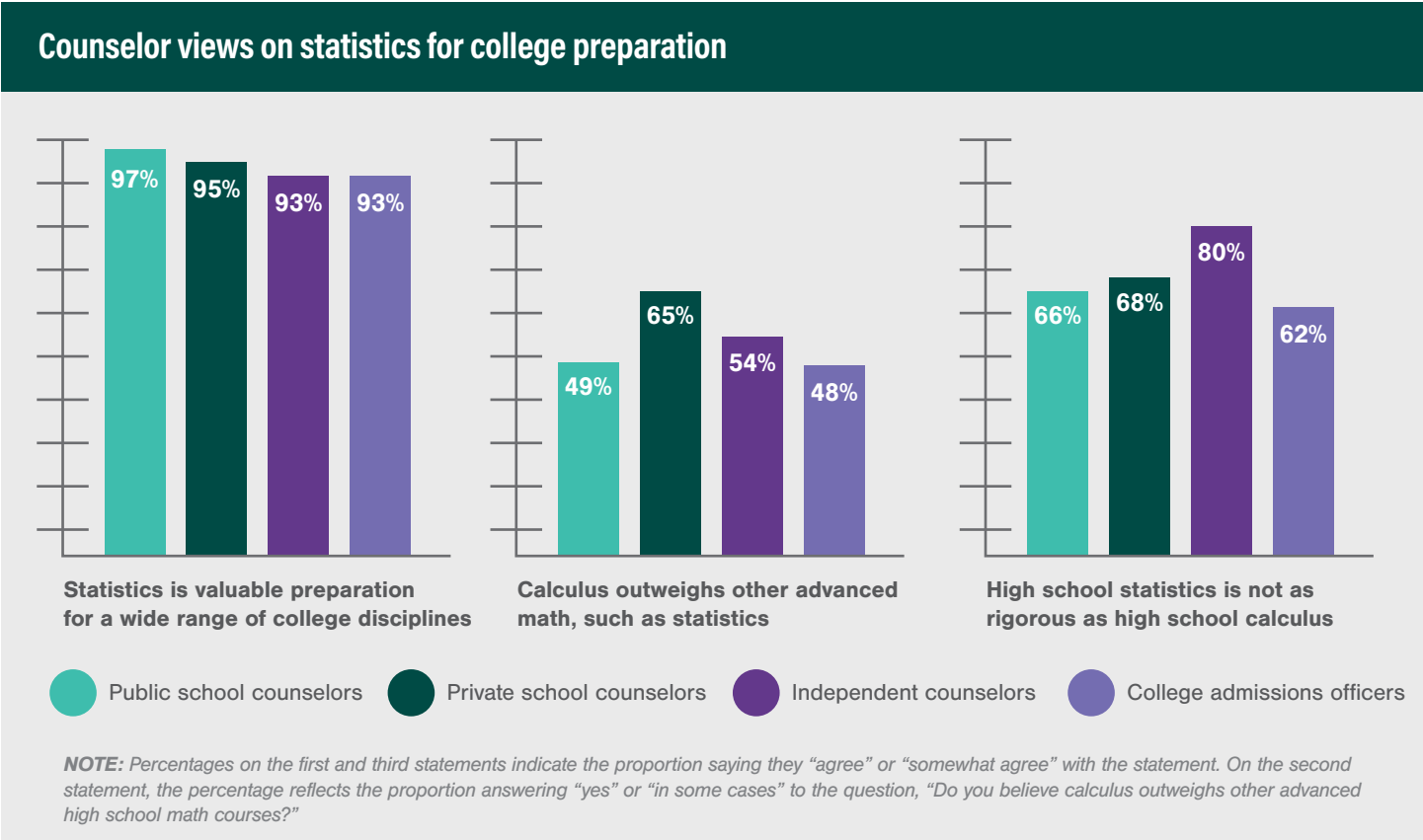
Only a few survey respondents (5 percent) said they recommend statistics equally with calculus, but more stated that they wish they could do so without risking their students' prospects at selective colleges:

I know that admissions officers consider AP Stats a B-level AP. I was one but couldn't tell you why.

Generally, yes [recommend AP Calculus], although we acknowledge that AP Statistics will be far more valuable during college.

Historically, some prestigious colleges—MIT, Stanford, Georgia Tech, Yale, and Princeton among them—don't give credit or placement for students who come in with AP Statistics (Sorenson, 2022). Others, such as the University of Washington, don't allow statistics to count toward the three math courses required for admission. The lack of academic regard for statistics is clearly frustrating to some counselors.

We believe that AP Statistics is a valuable class for anyone going into business, education, psychology, or medicine. It is viewed as more rigorous than AP Calculus at my school. Unfortunately, we feel we have to steer students toward AP Calc, based on the



MATH AND BUSINESS SCHOOL ADMISSIONS

Business schools represent an interesting case for examining the role of math in undergraduate admissions. In college, business majors are generally required to complete both calculus and statistics, often including two statistics courses (Ganter & Barker, 2004). The calculus course doesn't typically cover as much content as calculus taken by STEM students.

According to a committee of business school deans and professors convened by the Mathematics Association of America, a business calculus course should emphasize "the basic concepts and how they apply to business problems, with more attention to numerical methods and less to techniques of symbolic differentiation and integration" (Ganter & Barker, 2004, p. 20).

Responses to our survey suggested that many undergraduate business schools require—or are perceived to require—applicants to have a calculus course on their transcripts. However, preferences seem to differ by region, and even by school, creating notable confusion in some places for students trying to make the best choice. Several counselors explore the dilemma:

When students are considering business, we encourage AP Statistics when applicable.

Calculus ... is preferred by admission offices and required for students considering business or STEM majors.

Students who wish to pursue business in college think they should take stats not calc. We would love colleges to be clear on their preferences.

Of the two universities in our state with top business programs, one has told us they prefer students to have completed calculus prior to entry and the other has told us they prefer statistics prior to entry. So this can be a very confusing choice for students and families.

bias of college admissions.

Highly selective colleges think AP Calculus is harder than AP Statistics. There is a bias.

The most selective colleges virtually insist that applicants take the most rigorous roster available, and that means calculus over statistics—despite the fact that the vast majority of working adults will use statistics more than calculus.

We only recommend calculus because of the impact on admission. More students would be better served in statistics, but they have been negatively impacted in admission in the past.

But others note a shift. One private school counselor said that, over the past 11 years, students at his school have slowly moved away from calculus and toward statistics. Previously, 85 percent took calculus and 5 percent registered for statistics. Now, roughly 70 percent take calculus and 20 percent are in statistics at the school. While such high enrollment rates are outliers among high schools, a similar dynamic is beginning to play out nationally. Such changes are consistent with responses from counselors who say their schools are becoming more comfortable with advising students to stop at precalculus or take statistics instead of calculus.

This is the changing question. Ten years ago, we would recommend calculus over statistics. Now, we lean in more to their interests and see many more [non-STEM major] kids taking stats instead of calculus.

We are seeing a trend in college admissions where stats is starting to have equal footing as calc in some situations.

We recommend AP Calculus and AP Statistics equally.

Having worked on the college side and continuing to be a first reader for a large research university, I know the bias toward calculus in review. But I'm also seeing some movement away from that.

Some of my students interested in business, psychology, etc., certainly can make a case for taking



statistics or another math course. I encourage them to explain this decision on their application so there is no guessing on the part of the admission office about why they chose the math curriculum they chose.

PRESSURE COOKER

Many math education specialists have bemoaned the “race to calculus” for emphasizing speed instead of learning and conceptual understanding (Bressoud, 2020a; Daro & Asturias, 2019). Pinpointing the source of the pressure students face is not an exact science. Counselors tend to say that admissions offices expect calculus. Some admissions offices insist that their acceptance data only reflects the fact that large proportions of applicants take the course. Others see counselors as encouraging the trend, but a considerable number of counselors responding to our survey expressed deep reservations about the pressure students face to take advanced math courses.

Math unfortunately seems to rule our building. There is an unnecessary amount of pressure and stress to achieve the highest levels of math.

Our biggest concern is that many parents pressure their students to take more and more advanced math earlier and earlier. This often leads to unnecessary stress and struggle. In some cases it undermines math confidence for these students where, if they slowed down and took the more traditional path, reaching precalculus by their senior year, they might be more confident and perform better.

NONTRADITIONAL OPTIONS

High school math departments are beginning to offer new advanced courses or electives, but few are available in great numbers. One exception is personal finance, which is offered by 30 percent of the private high schools that participated in the survey and 69 percent of the public schools that did. As a possible explanation, 15 states now have a personal finance or financial literacy requirement for graduation (Next Gen Personal Finance, 2022). Some higher education institutions and systems also recognize the course (Burdman et al., 2018). In California, the California State University system explicitly listed personal finance as a course that might qualify for a proposed quantitative reasoning requirement, but the UC system does not list the course as meeting its admission requirements.

Twenty percent of public and 17 percent of private high school counselors said their schools offer discrete math. Data science was a more common offering at private schools, with 15 percent offering the course, compared with just 7 percent of public schools. Respondents submitted an array of responses when asked what other nontraditional math courses are available at their schools:

- Advanced Robotics
- Chaos Theory
- Cryptology (same school as topology)
- Cyber Security
- Financial Algebra
- Geometry of Islamic Art
- Group Theory
- Introduction to Proofs
- Logic & Computation
- Math for Carpentry and Construction
- Math in the Digital Arts
- Mathematical Models
- Philosophy of Mathematics
- Python
- Social Justice Math
- Sports Statistics
- Symmetry Science
- Topology

You can earn a PhD in a science field without taking calculus in HS—but [it's] hard to convince folks. Parents, and to some degree students, rely heavily on snippets of info rather than taking a deep dive into the process. Colleges do not help. ... Elite colleges and universities emphasize rigor, so if we have AP Calculus, students believe they must take it in order to be considered for admission.

Every engineering prof I have spoken to said a solid and thorough understanding of precalculus is enough. The cost to families and the amount of struggle and stress on students is beyond the pale.

It's less frequent that we have to push a kid to take AP Calculus than it's getting kids to rein things in, be reasonable, and not overschedule themselves and run themselves into the ground.

DISSENTING VOICES

Overwhelmingly, survey respondents said they don't believe calculus is necessary for all students. School counselors held this belief most strongly, with 94 percent saying they "agree" or "somewhat agree." That could be explained by the fact that they work with a wider range of students, including those not applying to college. But even admissions officers and independent counselors agree, though at slightly lower rates, that not all students need to learn calculus. Among respondents, 89 percent of admissions officers and 82 percent of independent counselors agreed or somewhat agreed.

So what explains the emphasis and what can be done about it? Some respondents placed the blame on colleges but were at a loss to explain their rationale.

They will say that calc is recommended/required, but when asked why, they can't provide a reason beyond admissions, meaning to be competitive in their pool, but not to be successful in college.

Most every math teacher I have spoken to in my 20-plus years of college counseling has been baffled by this preference by colleges and universities for students who take calculus.

I believe that colleges highly value (overvalue) calculus in admission. I think it's wrong of them to do so.

The fixation on calculus in college admissions offices is way out of line not only with what their own respective institutions are advising to students once they enroll (i.e., many more students could use statistics than calculus) but is also out of touch with 21st century workplace/industry trends, which demonstrably show that statistics is at least as useful—and in many instances is actually more useful—than calculus.

Others note that until students and families are persuaded that other courses will be valued by colleges, little will change:

I'd love for that to change to a broader range of courses fitting the bill on the math front, but that hasn't happened at the college level much at all and therefore not at high schools and certainly not in the views of students/families.

Aligning requirements with students' curricular needs would be more equitable, Moody Rideout of the University of Michigan suggested: "Instead of looking at calculus as equating to rigor, we should be asking the question instead how calculus relates to the current curriculum. What do our students actually need to know? What percentage of what students are learning in calculus do we actually use in the curriculum? That's what we are starting to do."

Some counselors support that approach.

It's unfortunate that for many schools, especially the more selective ones, calc is considered the gold standard. It should be more major specific. Does a history major or an education major really need calc? Is stats such a lesser class? I don't believe so. For many ... it's better. I truly get that calc is necessary for many business, tech or engineering majors. But I don't think it should count so highly in overall admissions.

Kids more interested in social science or humanities would be better served with stats, but the admissions process does not (yet) honor that.

We have been trying to address this conveyor-belt math approach at our school by validating the non-calculus route, which is, frankly, more appropriate for most of our students. I wish I didn't have to

keep dealing with this question, but as long as selective colleges view calculus as the holy grail of math courses, then I don't want our students to be disadvantaged by not taking this course.

Colleges place too much weight on calculus over a far more valuable statistics class.

If I made the rules ... stats (IB, AP, whatever) would be a requirement for HS graduation everywhere. It's as important as US Government or Civics or a course on federal and state constitutions for educated participants in a democracy. And besides that, it's valuable for most social science majors, STEM majors, and humanities majors.

I am a big proponent of statistics because of its usefulness in college and career but recognize that selective colleges still value calculus.

TIME FOR CHANGE

More students are taking nontraditional math classes. From 2009 to 2019, the proportion of high school graduates who took calculus declined from 18 to 16 percent, while those taking probability, statistics, and other analytical math (including finite and discrete math) climbed from 15 to 24 percent (National Center for Education Statistics, 2022). Though college admissions trends don't necessarily reflect these changes yet, counselors are beginning to reconsider the traditional guidance on math coursetaking. Even as there remains a need to expand access to calculus for groups traditionally excluded from advanced courses, broadening the range of advanced math courses to support the interests and aspirations of all students is essential.

With universities such as Stanford, Harvard, and the University of California recalibrating their emphasis on calculus in admissions, some counselors have adopted more flexible attitudes. In effect, they are beginning to trust that colleges, even highly selective ones, are less prescriptive about calculus than many suspect. AP Calculus is not the only way for students, especially those who are not focused on STEM pursuits, to distinguish themselves, they said:

I may suggest it only because it is AP and they like math, not because they are looking at a highly

selective school. We have over 27 AP classes that students can take, and AP Calculus does not have to be on their transcript, in my opinion."

I don't think that all students need to take calculus as they will never take it in college, so they should not feel the pressure to take it in high school.

I typically talk about a full four years of math. I have several kids who want to protect GPA or class rank or frankly ... hate or struggle with precalc and want stats.

Many more respondents are considering a change:

I would like more variety and options to offer non-engineering majors.

I have always recommended that students try to get to calculus, but I'm wondering if my advice is becoming outdated. Our math department feels that, for some kids, data science or AP Statistics might be a better fit, both in terms of preparation for certain college majors and for an individual's academic success.

We are certainly evaluating this very question about calculus versus other maths. Our sequential math program always leads toward calculus as the endgame. But should it? Increasingly, we think not.

My high school is in discussions about our new course, data science, and I've been toeing the line that students should still be gunning for calculus for the purpose of college admission. I'd love to be wrong!

For real change to happen, education leaders, policymakers, and professional organizations must focus on updating policies as well as ensuring they are transparent so that mindsets and practices align with them. Building on survey and interview responses, here are some ideas for what needs to happen next.

FOR COLLEGES AND UNIVERSITIES:

Adopt clear admissions policies and specific guidelines about math expectations for various schools and majors. In collaboration with faculty, admissions offices should reconsider how they weigh various math courses on students' transcripts in alignment with students' college goals. "It is the

admissions offices, not the math departments, at universities that need coaching on the merits of calculus for all students,” a college counselor argued. Math community resources, including those from the Charles A. Dana Center, can provide advice on the alignment of math pathways with different college majors and careers. Limiting the number of AP math courses for which students can receive a “GPA bump,” could also reduce extrinsic incentives for schools to promote hyperacceleration.”

Implement the policies consistently. It is important that admissions staff and anyone who reads applications understand the policies thoroughly, to ensure that vestigial biases don’t interfere with enactment. This includes providing thorough training for readers, as well as conducting data analysis to ensure that practices align with the policies. Counselors, teachers, and families won’t trust that policies have changed until they see them translated into practice. As one college counselor remarked, “This conversation is important to have, but until highly selective admissions change their actual decisions and include a wider selection of math classes, we are stuck.”

Commit to transparency in admissions policy and practice. Admissions offices can also take the lead on enhancing transparency around expectations. Instead of opaque advice to “maximize what’s available,” colleges can communicate, for example, that students should have x years of progressively advanced math aligned with their academic interests. Until new practices are convincingly implemented and communicated, many counselors will continue to advise students that skipping calculus could put their college ambitions at risk.

Develop shared resources. Colleges, math associations, and professional organizations such as NACAC can create shared materials with up-to-date information and infographics on alignment of math sequences with various majors and careers. These resources can help sustain ongoing conversations about refining admissions criteria with respect to math and help shift public perceptions about admissions practices. Efforts such as the 2019 Deans Commitment Letter, which acknowledged the value of placing limits on students’ AP enrollment, for example, could also support colleges in increasing transparency about math backgrounds of admitted students.

FOR STATE EDUCATION DEPARTMENTS, SCHOOL DISTRICTS, HIGH SCHOOLS AND MIDDLE SCHOOLS:

Invest in counseling for lower-resourced schools and students. On their own, the disparities in access to counseling for college planning and application present huge barriers to equitable college opportunity. Students whose parents didn’t go to college or who have felt marginalized by the education system may not realize their potential to attend and succeed in college. For most public schools, ultimately state resources will be necessary in order to significantly reduce student-to-counselor ratios to recommended levels.

Expand math offerings to include rigorous and relevant options aligned with college majors and careers. For example, students seeking to pursue most STEM majors would focus on the pathway to calculus, while students with an interest in the social sciences could pursue statistics and/or data science courses. (Students who change their mind and decide to pursue a STEM major should be permitted to enroll in Calculus pathway courses, with support if needed.)

Articulate college counseling with academic counseling beginning at the transition from elementary school to middle school. This would raise awareness of majors and careers, and ensure that no students are placed into dead-end sequences or prematurely tracked out of STEM opportunities. To change mindsets around calculus, statistics, and other advanced math, middle schools and high schools must be intentional early on about raising students’ and parents’ awareness about math pathways, college admissions, and planning for majors and careers. “I would recommend making information available to parents earlier—middle school for planning purposes—as it relates to majoring in engineering or business and taking calculus in high school,” noted one independent counselor.

Attend to students’ mental health and well-being. With the support of the Deans Commitment Letter, high schools can consider ways of minimizing the emphasis on acceleration, such as setting limits on the number of AP courses offered or the number students are allowed to take. Those providing multiple levels of advanced mathematics can reconsider the need for those offerings, while also ensuring more equitable access to those courses they continue to offer.

$$\sqrt{a^2} = |a| = \begin{cases} a, a \geq 0 \\ -a, a < 0 \end{cases}$$

$$(x^n)' = nx^{n-1}$$

$$\sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

$$(a^2 + ab + b^2) =$$

“As college admissions has been more frenzied, calculus becomes the checkbox. Never mind if you enjoy math or not. I would like to change that dialogue.”

– independent college counselor

$$1, 2$$

$$2a$$

$$y=2x$$

$$\sin \alpha = 2 \sin \frac{\alpha}{2} \cdot \cos \frac{\alpha}{2} \cdot$$

$$M = \frac{1}{2} \sum_{i=1}^{2q} i_i \sum_{j=1}^{2q} i_j$$

$$\frac{\pi}{2} - \text{ArcSin}(x)$$

$$\int x^{\alpha} \cdot dx = \frac{x^{\alpha+1}}{\alpha+1} + c$$

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