Calculus in High School
Too much of a good thing?

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PowerPoint available at
www.macalester.edu/~bressoud/talks

Oregon State University
Corvallis, OR
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In the Fall of 2011: 240,000 students entered four-year undergraduate programs with the intention of majoring in engineering, a physical science, mathematics, or statistics.

Less than half will succeed.
Students in college or university Calculus I:

- mean score on SAT Math: 652
  - 75% earned 610 or higher (top 23%)
- mean score on ACT Math: 28.5
  - 75% earned 26 or higher (top 16%)

MAA survey of 700 instructors, over 14,000 students, all types of colleges and universities across US, Fall 2010
61% all Calculus I students took a calculus class in high school. 61% of them earned an A (37% of all Calc I students)

For 69% of those took Calc in HS, it was an AP Calculus course (42% of all Calc I students).

81% of the AP Calculus students took the AP exam (34% of all Calc I students)

60% of those who took the exam earned a 3 or higher (just over 20% of all Calc I students)

MAA survey of 700 instructors, over 14,000 students, all types of colleges and universities across US, Fall 2010
Grade for college Calculus I:

22% A

28% B

23% C

27% D, F, or Withdrew
Me and AP:

1968 took AP Calculus exam

1990–1991 taught AP Calculus at State College Area High School

1993–2007 AP Reading  
(Reader, Table Leader, Question Leader)

1999–2005 AP Calculus Development Committee  
(Chair from 2002 to 2005)
The Chronicle of Higher Education

January 17, 2010

The Rocky Transition From High-School Calculus

http://chronicle.com/article/High-School-Calculus-The-E/63533/
About 650,000 students are studying calculus in high school this year, over 1/3 of the 1.8 million who will go directly from HS to college.
Math-intensive Bachelor's degrees relative to number of 22 year-olds (degrees ÷ # of 22-year olds)

NCES & US Census data
A quick History of AP Calculus
1953–55: College Admission with Advanced Standing

Bowdoin, Brown, Carleton, Haverford, Kenyon, MIT, Middlebury, Oberlin, Swarthmore, Wabash, Wesleyan, and Williams

1956: First Advanced Placement exams administered by College Board

Gordon Chalmers (right), President of Kenyon College, with Thornton Wilder
1970’s and 1980’s

1988

Jaime Escalante

1984: South Carolina’s Education Improvement Act

Richard Riley, Governor of South Carolina at the time, later Secretary of Education under President Clinton
1990’s

1995: Graphing Calculators

1998: AB subscore

Today, two-thirds of the exam is calculator-free, one-third allows and may require use of graphing calculator.

Students who do best on both parts of exam have teachers who allow use of calculators $\frac{1}{4}$ to $\frac{1}{2}$ of time.
Gasper Caperton, College Board President since 1999

2000’s

2007: AP Course Audit
How effective is AP Calculus?
Morgan & Klaric, 2007: study of 22 colleges and universities in fall, 1994; grades weighted so that SAT scores are comparable

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<th>Placed via</th>
<th>average grade in Calculus II</th>
<th>SAT Adjusted grade</th>
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<td>3.46</td>
<td>3.27</td>
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Performance of students who used AP credit to go straight into Calculus II

<table>
<thead>
<tr>
<th>AB score</th>
<th>Average Grade in Calc II</th>
<th>BC score</th>
<th>Average Grade in Calc II</th>
</tr>
</thead>
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<td>3</td>
<td>B</td>
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<tr>
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<td>B-/B</td>
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<td>B+</td>
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<tr>
<td>5</td>
<td>B+</td>
<td>5</td>
<td>B+</td>
</tr>
</tbody>
</table>

Morgan & Klaric (1994) study of 22 colleges and universities*
Keng & Dodd (2001) study at U of Texas, Austin
   grades weighted so that SAT scores are comparable to those of students who had not skipped Calculus I

Students who earned 3 or higher on AB exam and chose to retake Calculus I did worse in Calculus II then those who went directly to Calculus II.

_Caveats_: Difference was statistically significant at .05 only 1 out of 4 years.

Not controlled for comparability of ability levels
Students who study Calculus in HS and do well on AP exam (≥ 3 on AB exam) do significantly better in Calculus I as well as intro Biology, Chemistry, and Physics.

There is little discernible benefit from simply taking Calculus in High School.
Of the high school students who graduated in 1992 and earned credit for “calculus” while in high school, 31% took *precalculus* in college, and a further 32% took *no calculus* in college.

Of the high school students who graduated in 2004 and earned credit for “calculus” while in high school, 17% took *remedial mathematics* in college.

NCES, NELS:88 and ELS:2002/06 data.
Those who do not have access to a good calculus program in high school are at a serious disadvantage in pursuing engineering or science.

All evidence suggests that calculus in high school works well for most of the roughly 25% who earn college credit.

We don’t know enough about the other 75%.
MAA/NCTM Joint Position on Calculus  
(adopted March 2012)

1. Students who enroll in a calculus course in secondary school should have demonstrated mastery of algebra, geometry, trigonometry, and coordinate geometry;
MAA/NCTM Joint Position on Calculus
(adopted March 2012)

2. The calculus course offered in secondary school should have the substance of a mainstream college-level course;
MAA/NCTM Joint Position on Calculus
(adopted March 2012)

3. The college curriculum should acknowledge the ubiquity of calculus in secondary school, shape the calculus curriculum so that it is appropriate for those who have experienced introductory calculus, and offer alternatives to calculus.

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