Ahead of the Game? Course-Taking Patterns under a Math Pathways Reform

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The multiple contexts around math-education reform

- Math achievement—and taking advanced courses—feature prominently in discussions of school performance & international competitiveness
  - Advanced math coursework linked with longer-run economic success (e.g., Altonji, 1995; Goodman, 2019; Long et al., 2012)

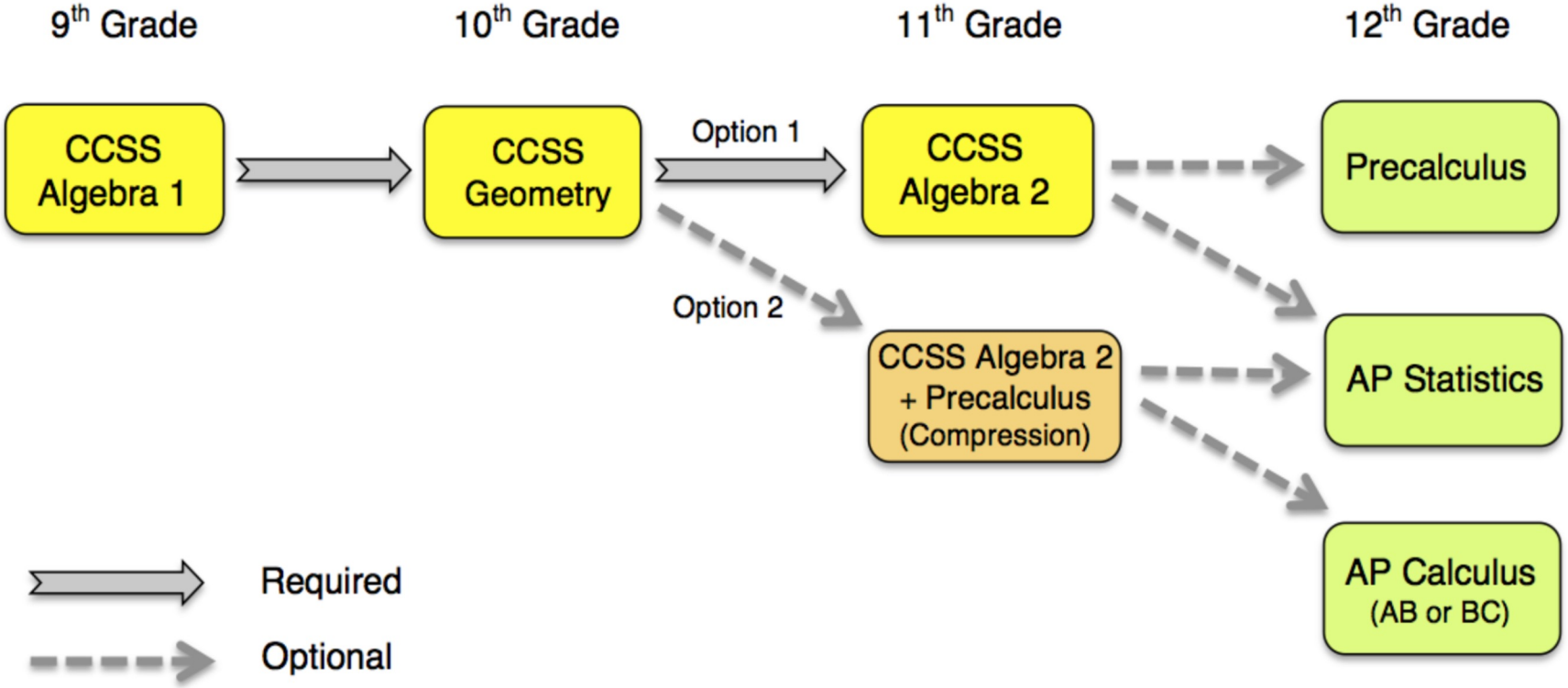
- Large & persistent ethnoracial gaps in advanced-math take-up
  - Calculus among 2019 HS graduates (US DoED, 2021): Black (6%), Hispanic (9%), white (17.5%), Asian (43%)

- During the CCSS transition period, a backlash to an earlier movement to accelerate math (e.g., grade-8 “Algebra for All”)

San Francisco's Math Pathways Reform

- In 2014, SFUSD replaced its grade-8 Algebra I course with CCSS Math 8 and CCSS Algebra I, arguing it was "much more rigorous"

- These changes were also part of a large "Pathways" reform that placed Algebra I in 9th grade & encouraged no "curricular branching" (i.e., no tracking) before 11th grade..


9th Grade
10th Grade
11th Grade
12th Grade
CCSS Algebra 1
CCSS Geometry
Option 1
CCSS Algebra 2
Precalculus
Option 2
CCSS Algebra 2 + Precalculus (Compression)
AP Statistics
AP Calculus (AB or BC)
Required
Optional

San Francisco's Math Pathways Reform

- SFUSD motivated this change as a rejection of acceleration that compelled students to make consequential decisions at a younger age
  - "Why is no one else compressing like us? We're ahead of the game…Others considered going our way, but found it too hard. San Francisco always goes first, the rest eventually catch up"—Superintendent Carranza

- Concerns about equity also figured prominently. Superintendent Carranza noted that at one high-performing SFUSD high school
  - "Of the 928 students who took those AP Math courses at this high school over the past two years, only 7 were African American, and only 21 were Latino: NOT 7 and 21 percent, **but 7 and 21 actual students."**

San Francisco's Math Pathways Reform

- SFUSD stated that they would maintain an option for HS students to take Algebra I and Geometry simultaneously and that students would not be diverted from advanced math

- Some parents and community members are engaged in significant and sustained opposition to the reform, criticizing both the Alg2/Precalculus compression course and a "leveling down" approach to equity

- The contentious debate has centered on competing perspectives on how "advanced" math course-taking has changed under the reform

- **Our study seeks to provide independent evidence on this question**

Data

- Student-level transcript data used to build longitudinal profiles of HS math course-taking across six cohorts of SFUSD students (n=23,309)

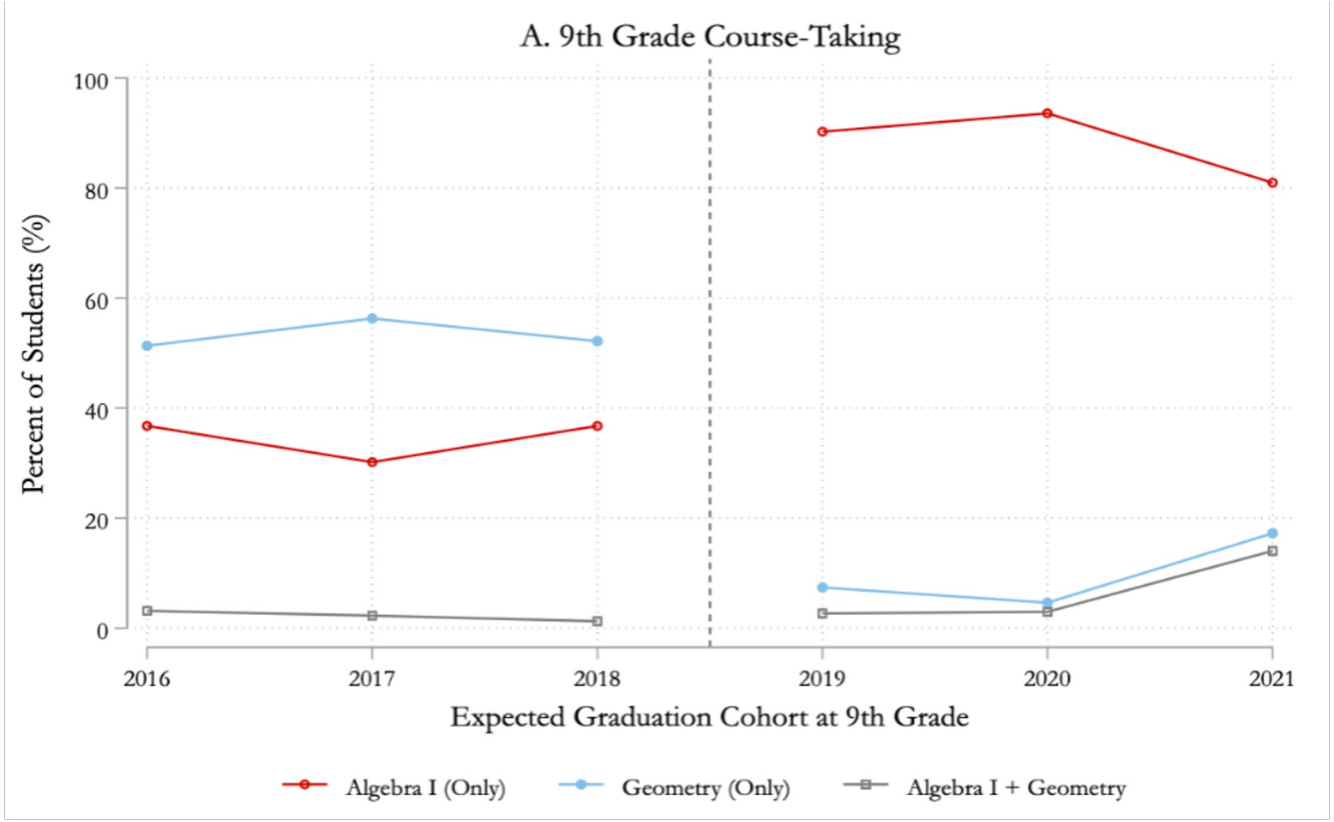
- We define graduation cohorts based on when they first entered grade 9 for 3 pre-reform cohorts (classes of 2016, 2017, & 2018) and 3 post-reform cohorts (classes of 2019, 2020, and 2021)
  - Similar results when focused on graduating students (figures A2-A4)

- Paralleling the debate, we focus on course-taking but find similar results when focused on course completion (Tables A5, A6)

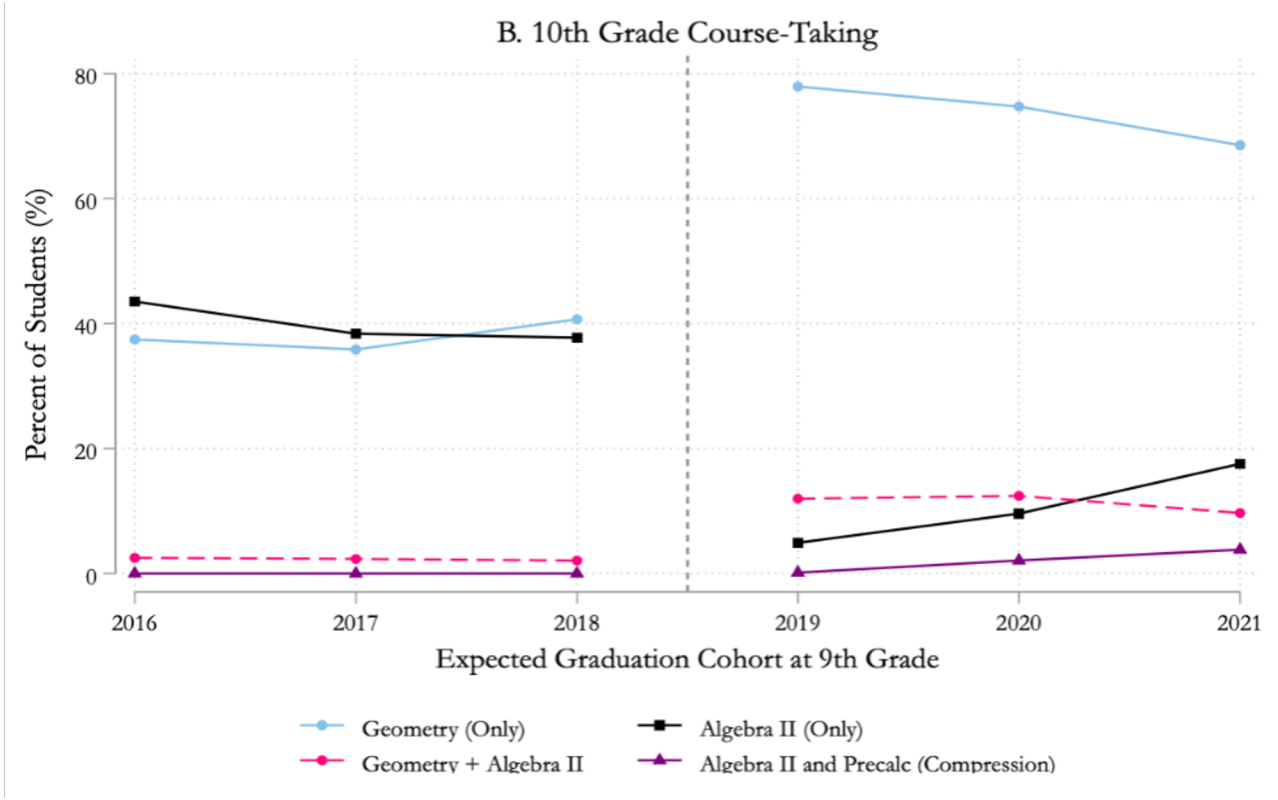
- Following IES guidance for descriptive research, we do not center inference but do show two forms of inference in the appendix
  - Obviously not causal but “post hoc ergo propter hoc”?

Results

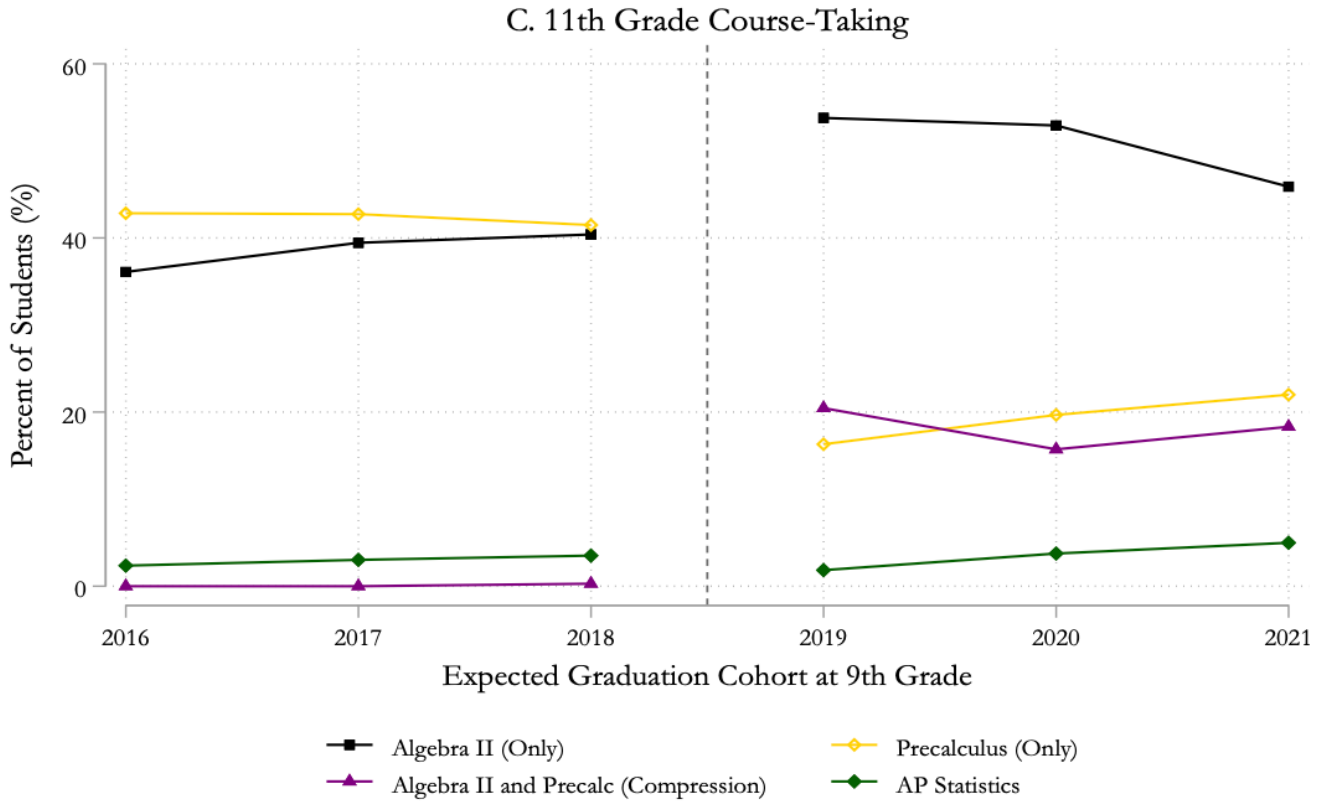
Grade 9: Dramatic shift to Algebra & from Geometry



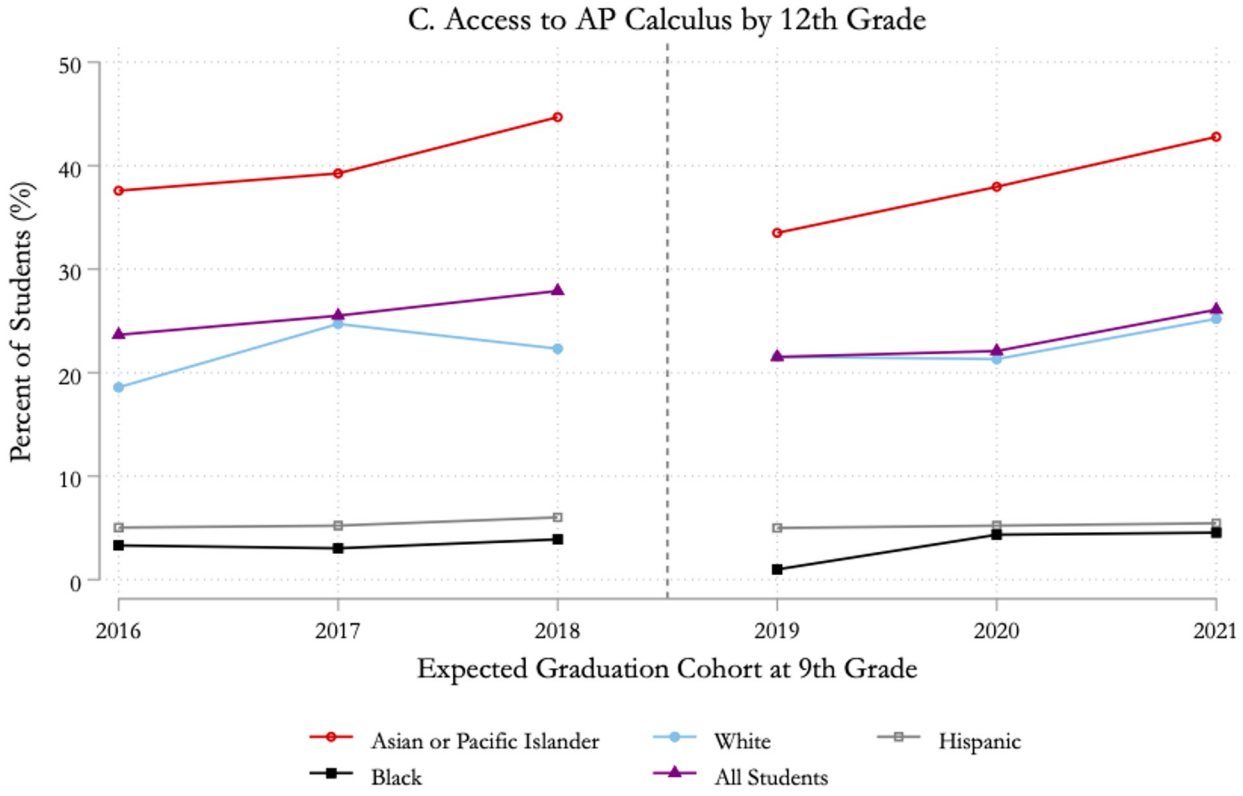
Grade 10: Dramatic shift to Geometry & from Algebra 2



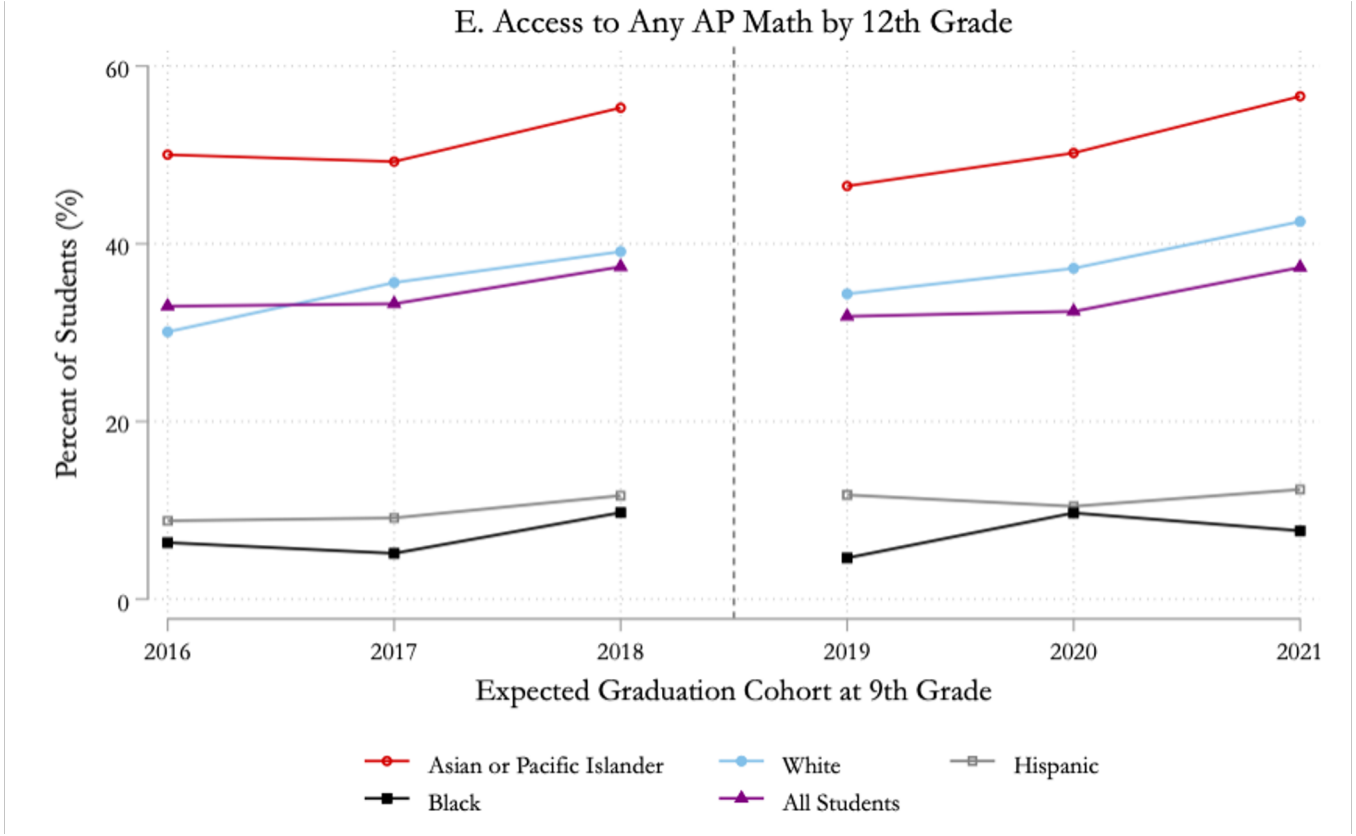
Grade 11: More A2/compression; less full-year Precalculus



Drop in AP Calc followed by recovery due to acceleration



More recovery when focusing on any AP Math course



Conclusions

- Participation in Advanced Placement (AP) math initially fell 15% (6 pp.) driven by declines in AP Calculus and among Asian/Pacific-Islander students.

- Growing take-up of acceleration options attenuated this initial decline
  - Sustained drop in AP Calculus (2.4 pp.) balanced by growth in AP Statistics

- Ethnoracial gaps in AP math remained largely unchanged

Implications?

- Fitting a 5-year course sequence (A1→AP Calc) in 4 years of high school implies confronting tradeoffs
  - The Alg2/Precalc compression course not recognized as Precalculus by state universities
  - Acceleration in grades 9 and 10? Is acceleration in grade 8 really so much worse?
  - Deeper questions about the content knowledge within each course name & what we want students to know (e.g., Calculus vs. Statistics?)

- A need for new insights (an "equity audit"?) about the persistent barriers to representation in advanced math
  - Is it the quality of earlier pedagogy and opportunities, the character of course advising, the availability of advanced courses at all schools, or all of the above?