WHY DO I HAVE TO REPEAT ALGEBRA IN COLLEGE?

THE EQUITY COST OF COLLEGE READINESS STANDARDS MISALIGNMENT

Tatiana Melguizo
University of Southern California

The Mathematics of Opportunity
University of California Berkeley
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Problem Statement

• Over 60% of low-income and minoritized students first enroll at a community college (Dalton, Ingels, & Fritch, 2016)

• About 70% of high school students are placed in developmental math as they transition to community college

• A recent meta-analyses of rigorous studies evaluating developmental math on a number of educational outcomes suggest that students are not benefitting from these courses (Valentine, Konstantopoulos, & Goldrick-Rab, 2017)
Use Linked Transcript Data to Explore the Equity Costs of Inter-Sector Misalignment in Math (ISMM)

• Nationwide, there seems to be agreement towards using high school transcript information to place students in developmental education
  • Formal data linkages between high school and community college districts are not common place (Dynarski & Berends, 2015)

• In the context of a Research-Practitioner Partnership (RPP), we leverage access to a linked transcript dataset between two large urban high school and community college districts (LUSD, LUCCD) to explore the equity costs of inter-sector misalignment in math (ISMM)
Inter-sector Math Misalignment (ISMM)

1. ISMM: the proportion of students who, according to their high school transcripts and high school standards, were deemed “college ready” in math but were placed in developmental math when they transitioned to community college.

2. Explore whether the problem is more pronounced for racially minoritized students, as a way to measure the equity costs of inter-sector math misalignment.
Overview of Data

LAUSD Students

LACCD Students
F2005-F2014

Linked Records for 104,994 Students (89%)

- Los Angeles HS or “Other” w/in 3 years
- Assessed in Math + Enrolled
- Assessed in Eng. + Enrolled
N=118,649

Other Postsecondary
Dropout
Includes students who have a cumulative GPA and an 11th grade CST result, whose highest math was algebra 2 or higher, and who received a college math placement.

**LAUSD Data**
- Demographics
- CA High School Exit Exam (CAHSEE) scores (math, ELA)
- California Standards Test (CST) scores (math, ELA, science, social science)
- Early Assessment Program
- GPA
- Transcripts (All courses taken and grades)
- Special Education

**LACCD Data**
- Demographics
- Placement Test Scores in Math and English
- Credits Attempted/Completed by Term
- Transcripts/Enrollments (All courses taken and grades)
- Degree Outcomes through fall 2016
<table>
<thead>
<tr>
<th>Last HS Math Course</th>
<th>Algebra 2</th>
<th>Trig/Pre-Calculus</th>
<th>Statistics</th>
<th>Calculus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Trig/Pre-Calculus</td>
<td>18</td>
<td>8</td>
<td>8</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>Statistics</td>
<td>24</td>
<td>17</td>
<td>14</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Calculus</td>
<td>30</td>
<td>23</td>
<td>20</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>23</td>
<td>20</td>
<td>10</td>
<td>26</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cumulative HS GPA</th>
<th>Basic Math</th>
<th>Arithmetic</th>
<th>Pre-Algebra</th>
<th>Algebra 1</th>
<th>Algebra 2</th>
<th>Transfer-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.7-3.7</td>
<td>0</td>
<td>9</td>
<td>17</td>
<td>24</td>
<td>33</td>
<td>17</td>
</tr>
<tr>
<td>&gt;3.7</td>
<td>0</td>
<td>3</td>
<td>9</td>
<td>11</td>
<td>32</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>0</td>
<td>9</td>
<td>16</td>
<td>23</td>
<td>33</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inter-Sector Math Misalignment</th>
<th>ISMM: Minor (&lt;25%)</th>
<th>Moderate (25-50%)</th>
<th>Substantial (50-75%)</th>
<th>Severe (&gt;75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Placed in Dev. Math</td>
<td>0</td>
<td>3</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

Table. College math placement by college-readiness indicator (%)
### Evidence of Equity Costs of ISMM

Table. College math placement by college-readiness indicators, disaggregated by race (%)

<table>
<thead>
<tr>
<th>College Math Placement</th>
<th>Basic Math</th>
<th>Arithmetic</th>
<th>Pre-Algebra</th>
<th>Algebra 1</th>
<th>Algebra 2</th>
<th>Transfer-Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest HS Math (&gt;B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>14</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>Black</td>
<td>2</td>
<td>28</td>
<td>24</td>
<td>23</td>
<td>19</td>
<td>4</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0</td>
<td>14</td>
<td>23</td>
<td>26</td>
<td>28</td>
<td>9</td>
</tr>
<tr>
<td>White</td>
<td>0</td>
<td>5</td>
<td>6</td>
<td>18</td>
<td>37</td>
<td>34</td>
</tr>
<tr>
<td>11th Grade CST Math: Proficient or Advanced</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>24</td>
<td>70</td>
<td>6</td>
</tr>
<tr>
<td>Black</td>
<td>4</td>
<td>11</td>
<td>7</td>
<td>40</td>
<td>38</td>
<td>22</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>40</td>
<td>40</td>
<td>19</td>
</tr>
<tr>
<td>White</td>
<td>0</td>
<td>2</td>
<td>5</td>
<td>29</td>
<td>64</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>6</td>
<td>7</td>
<td>35</td>
<td>51</td>
<td>14</td>
</tr>
</tbody>
</table>

Inter-Sector Math Misalignment
- ISMM: Minor (<25%)
- Moderate (25-50%)
- Substantial (50-75%)
- Severe (>75%)
Discussion

• Initial results show many “college-ready” students were placed in lower-level math courses after A&P processes
  → Inefficiencies in transition to college with substantial equity costs
  → Need to find better measures for math placement
• We found evidence that the cost of inter-section misalignment and lack of college-ready standards at the time affected more African American and Latino students than their Asian American and White peers
• California recently passed AB 705 that requires colleges to place students in math and English level courses directly. This is a step in the right direction but the potential of real change lies on the college-level implementation
The Cost of Inter-Sector Misalignment for English Language Learners and STEM Aspiring Student

- Melguizo, T., Flores, S.M., Carrol, T., & Velasquez, D. (In progress). Identifying secondary school to community college curricular misalignment for English Learners: Race, ethnicity, language fluency. Rossier School of Education, University of Southern California.

- Park, E.S., Ngo, F., & Melguizo, T. (In progress). The role of misaligned math in helping or hindering STEM-aspiring students in community colleges. Rossier School of Education, University of Southern California.
Let Icarus Fly: Following the evidence to rediscover students’ capacity in mathematics

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Senior Director of Data Science
Educational Results Partnership
jhetts@edresults.org
@jjetts #LetIcarusFly

Mathematics of Opportunity
November 5, 2018

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Transitions & intersegmental trust – K12 to CCC

- **Within systems**
  - Highly reliable progression with C or better

- **Between systems**
  - ~3/4 repeat ≥ 1 level, e.g.,
    - 76% of students who successfully complete Algebra 2
    - 68% of students w/B or better
    - 60% of students w/As
  - ~1/2 repeat ≥ 2 levels, e.g.,
    - 47% of students who successfully complete PreCalculus
    - 39% of students w/B or better
    - 33% of students w/As
Accuplacer, SAT, ACT - Alaska

Figure 7. Among University of Alaska students who enrolled directly in college math courses, high school grade point average explained more of the variation in college math grades than did exam scores, 2008/09–2011/12

Multiple Measures Assessment Project

- Ongoing, collaborative effort of CCCC0, Common Assessment Initiative (CAI), Cal-PASS Plus (Educational Results Partnership), RP Group and now >90 CCC pilot colleges

- Identify, analyze, & validate multiple measures data (including HS transcript data, non-cognitive variable data, & self-report HS transcript data)

- Predict course success using classification & regression tree models (robust to missing data, non-linear effects, and interactions)
  - Very conservative approach: identify students with success rate ≥70%

- Engage pilot colleges to conduct local replications, test models and pilot use in placement, and provide feedback
# MMAP Placement/Support Recommendations: Mathematics

<table>
<thead>
<tr>
<th>Placement</th>
<th>Statistics</th>
<th>Precalculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry-level transfer-level courses (Direct placement)</td>
<td>HSGPA ≥ 3.0 or HSGPA ≥ 2.3 and ≥C in Precalculus</td>
<td>HSGPA ≥ 3.4 or HSGPA ≥ 2.6 and enrolled in Calculus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comparison Group</th>
<th>Comparison Metric</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students in transfer-level courses by previously methods in same term</td>
<td>Success rates</td>
<td>MMAP success rates equal</td>
</tr>
</tbody>
</table>
Adapting MMAP to AB 705

- MMAP decision trees identified students highly likely to succeed
  - $\geq 70\%$ probability of success in transfer-level
- Now, only can be assigned to dev ed if:
  - *highly unlikely* to succeed at the transfer-level class AND
  - probability of successful completion of transfer-level course within one year (*throughput*) is maximized
- Have to examine students least likely to succeed based on HS performance (lowest GPA)
## Likelihood of success: Mathematics

<table>
<thead>
<tr>
<th>Placement</th>
<th>Statistics</th>
<th>Precalculus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly likely to succeed (Direct placement)</td>
<td>HSGPA ≥ 3.0</td>
<td>HSGPA ≥ 3.4</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>HSGPA ≥ 2.3 and ≥C in Precalculus</td>
<td>HSGPA ≥ 2.6 and enrolled in Calculus</td>
</tr>
</tbody>
</table>

Transfer-Level Course Completion in One Year from First Class in Discipline (error bars represent ±1 se)

- **Statistics (HS GPA < 2.3)**
  - Lowest Node: N=1,485
  - Regression: N=809
  - 1 level below: N=11,309
  - Lowest Node Success: 40%
  - Regression Adjusted Success: 29%
  - Throughput from 1 level below: 8%

- **Pre-Calculus (HS GPA < 2.6)**
  - Lowest Node: N=1,753
  - Regression: N=661
  - 1 level below: N=18,917
  - Lowest Node Success: 38%
  - Regression Adjusted Success: 28%
  - Throughput from 1 level below: 13%

[bit.ly/AB705Adjustments]
# Placement/Support Recommendations: Transfer-level Mathematics for Everyone

<table>
<thead>
<tr>
<th>Support Recommendation</th>
<th>Transfer-Level Statistics/Liberal Arts Mathematics</th>
<th>Entry-level BSTEM Mathematics (designed using Precalculus)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct placement</td>
<td>HSGPA ≥ 3.0</td>
<td>HSGPA ≥ 3.4</td>
</tr>
<tr>
<td>(no support recommended)</td>
<td>OR HSGPA ≥ 2.3 and ≥C in Precalculus</td>
<td>OR HSGPA ≥ 2.6 and enrolled in Calculus</td>
</tr>
<tr>
<td>Additional academic and concurrent support recommended</td>
<td>HSGPA 2.3–3.0</td>
<td>HSGPA ≥ 2.6 or enrolled in Precalculus</td>
</tr>
<tr>
<td>Additional academic and concurrent support strongly recommended</td>
<td>HSGPA &lt; 2.3</td>
<td>HSGPA ≤ 2.6 and no Precalculus</td>
</tr>
</tbody>
</table>

For more information, see the July, 2018 AB705 Implementation Memo at https://assessment.cccco.edu/resources/
Preliminary findings on corequisite success rate by GPA Band – BSTEM Corequisites (Cuyamaca College)

Students with high school transcript data available in CalPASS Plus with verified enrollments in either Business Calculus or Pre-Calculus AND a simultaneous corequisite course – n = 63
Preliminary findings on corequisite success rate by GPA Band – Statistics Corequisite (Cuyamaca & Los Medanos)

Students with high school transcript data available in CalPASS Plus with verified enrollments in either Statistics AND a simultaneous corequisite course – n = 498
Increasing Math Readiness through Collaboration

Dr. Joy L. Salvetti

Center for College & Career Readiness
Collective Impact Model

Regional Partnership Infrastructure

In response to CAASPP scores in our region, together we developed more math options for more students, allowing more students to take a fourth year of math.

New Aligned Courses:
- EAP Senior Year Mathematics (ESM) C-Approved
- EAP Quantitative Reasoning (EQR) G-Approved
Mitigating System Change

Regional Partnership Infrastructure

In response to CAASPP scores in our region, together we developed more math options for more students, allowing more students to take a fourth year of math.

New Aligned Courses:
- EAP Senior Year Mathematics (ESM) C-Approved
- EAP Quantitative Reasoning (EQR) G-Approved

In partnership, we can navigate system-wide policy change together...

K-12:
SBAC & Common Core Alignment
- Community Colleges:
  - Assembly Bill 705
- CSU:
  - Executive Orders 1100 & 1110
# Increased Student Participation

<table>
<thead>
<tr>
<th>Academic Year</th>
<th># Students Participating in ESM</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016 – 2017</td>
<td>800</td>
</tr>
<tr>
<td>2017 – 2018</td>
<td>1600</td>
</tr>
<tr>
<td>2018 – 2019</td>
<td>1800</td>
</tr>
</tbody>
</table>
## Preliminary ESM Course Outcomes

### Pass Rate for Non-ESM & ESM Courses

*By 11th Grade CAASPP Scores*

<table>
<thead>
<tr>
<th>CAASPP Levels</th>
<th>Non-ESM*</th>
<th>ESM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &amp; 2</td>
<td>63%</td>
<td>85%</td>
</tr>
<tr>
<td>3 &amp; 4</td>
<td>85%</td>
<td>93%</td>
</tr>
</tbody>
</table>

### Pass Rate for Non-ESM & ESM Courses

*By Ethnicity*

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Non-ESM*</th>
<th>ESM</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>65%</td>
<td>79%</td>
</tr>
<tr>
<td>Asian American</td>
<td>73%</td>
<td>89%</td>
</tr>
<tr>
<td>Latino American</td>
<td>59%</td>
<td>84%</td>
</tr>
<tr>
<td>Multiracial</td>
<td>72%</td>
<td>89%</td>
</tr>
<tr>
<td>White</td>
<td>80%</td>
<td>92%</td>
</tr>
</tbody>
</table>

*Non-ESM* refers to courses students would have taken their senior year that are comparable to ESM such as Statistics and Pre-Calculus. AP/Honors courses were not considered.
Multiple Measures for Placement

- Standardized Tests: CAASPP/EAP, ACT, SAT, AP, IB, and CLEP
- High School Grade Point Average (GPA)
- High School and College Coursework*
  
Coursework must be completed with a C- or better
- High School Math GPA

The CSU will use the highest achieved measure to determine placement in the appropriate GE English and math/QR course.
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