The Multiple Measures Assessment Project
Re-Envisioned: Supporting the system’s leap forward under AB 705

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The RP Conference
Long Beach, CA

Agenda

- Requirements of AB 705
- Review of MMAP and results to date
- Adapting MMAP to AB 705
- Examination of success in statistics
- Update on variability among colleges
- Addressing “double placement”
- Placement and support recommendations for English, Statistics and Gateway STEM Math
- Discussion
AB 705 (Irwin) requirements

• Use of high school performance data
• Use of “highly unlikely” standard
• Maximize student’s probability of completing transfer-level English and math in their first year
• Optimize student’s probability of completing ESL sequence in three years
Brief Overview of the Multiple Measures Assessment Project (MMAP)
Data Set for the Models

• CCC students enrolled in an English, Math, Reading or ESL class with matching high school data in Cal-PASS Plus
  • ≈1 M cases for Math & English; ≈200k for Reading & ESL

• Bulk of data from 2008 through 2014
• Rules built from students with 4 years of high school data (≈25% of sample)
  — 70% probability of success or higher required for transfer placement

• MMAP code (http://bit.ly/MMAP_code)

Variables Explored in the Models

• High school unweighted cumulative GPA
• Grades in high school courses
• CST scores
• Advanced Placement (AP) course taking
• Taking higher level courses
• Delay between high school and community college
• HS English types (expository, remedial, ESL)
• HS math level (Elem Algebra, Integrated Algebra, Pre-Calculus)
### Transfer-Level Placement Recommendations

<table>
<thead>
<tr>
<th>Transfer Level Course</th>
<th>Direct Matriculant</th>
<th>Non-Direct Matriculant</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Algebra (STEM), Passed Algebra II (or better)</td>
<td>HS 11 GPA &gt;=3.2 OR</td>
<td>HS 12 GPA &gt;=3.2 OR</td>
</tr>
<tr>
<td></td>
<td>HS 11 GPA &gt;=2.9 AND Pre-Calculus C (or better)</td>
<td>HS 12 GPA &gt;=3.0 AND Pre-Calculus or Statistics (C or better)</td>
</tr>
<tr>
<td>Statistics (General Education/Liberal Arts), Passed Algebra I (or better)</td>
<td>HS 11 GPA &gt;=3.0 OR</td>
<td>HS 12 GPA &gt;=3.0 OR</td>
</tr>
<tr>
<td></td>
<td>HS 11 GPA &gt;=2.3 AND Pre-Calculus C (or better)</td>
<td>HS 12 GPA &gt;=2.6 AND Pre-Calculus (C or better)</td>
</tr>
<tr>
<td>English</td>
<td>HS 11 GPA &gt;=2.6</td>
<td>HS 12 GPA &gt;=2.6</td>
</tr>
</tbody>
</table>

Success Rates in Transfer-level English

- Sierra, 2014F: MMAP 79%, Other 73%
- Shasta, 2015S: MMAP 67%, Other 68%
- San Diego CCD, 2015F: MMAP 79%, Other 68%
- Norco, 2016F: MMAP 69%, Other 69%
- MiraCosta, 2016S: MMAP 67%, Other 65%
- MiraCosta, 2016F: MMAP 80%, Other 68%
- Merritt, 2015M-2016S: MMAP 56%, Other 50%
- Las Positas, 2016F: MMAP 77%, Other 75%
- Laney, 2015M-2016S: MMAP 71%, Other 76%
- Irvine Valley, 2016F: MMAP 85%, Other 77%
- College of Alameda, 2015M-2016S: MMAP 78%, Other 78%
- Canada, 2014F/2015F: MMAP 72%, Other 76%
- Berkeley, 2015M-2016S: MMAP 73%, Other 62%

bit.ly/MMAPSummary2017
Success Rates in Transfer-level Math

- San Diego CCD, 2015F: 60% Other, 58% MMAP
- Merritt, 2015M-2016S: 75% Other, 71% MMAP
- Norco, 2016F: 59% Other, 69% MMAP
- Laney, 2015M-2016S: 75% Other, 77% MMAP
- College of Alameda, 2015M-2016S: 85% Other, 79% MMAP
- Canada, 2014F/2015F: 76% Other, 70% MMAP
- Berkeley, 2015M-2016S: 51% Other, 46% MMAP

Other vs MMAP

bit.ly/MMAPSsummary2017
# Summary of Differences Between MMAP and Students Placed Traditionally - English

<table>
<thead>
<tr>
<th>Comparison Group</th>
<th>Metric</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students in transfer-level courses in same term</td>
<td>Success rates</td>
<td>MMAP success rates 2 percentage points (pp) higher</td>
</tr>
<tr>
<td>Students placed 1 level below in previous year</td>
<td>Completion of transfer-level English in 2 years</td>
<td>MMAP throughput 26 pp higher</td>
</tr>
<tr>
<td>Students placed 2 levels below in previous year</td>
<td>Completion of transfer-level English in 2 years</td>
<td>MMAP throughput 40 pp higher</td>
</tr>
</tbody>
</table>
### Summary of Differences Between MMAP and Students Placed Traditionally - Math

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<td>Success rates</td>
<td>MMAP success rates equal</td>
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<tr>
<td>Students placed 1 level below in previous year</td>
<td>Completion of transfer-level Math in 2 years</td>
<td>MMAP throughput 41 pp higher</td>
</tr>
<tr>
<td>Students placed 2 levels below in previous year</td>
<td>Completion of transfer-level Math in 2 years</td>
<td>MMAP throughput 53 pp higher</td>
</tr>
</tbody>
</table>
Summary of MMAP Classic

– Success rates of students placed by MMAP are ≥ students placed directly into transfer-level using the institutions traditional placement method
  • even though MMAP placement 2-5X increase into transfer level courses
– Successful completion of transfer level course (throughput) is 20 (English) to 40 (Math) percentage points higher than for students placed even just one level below.
– Implementation of MMAP rules can be nuanced
  • Don’t use statistics rules to place into trigonometry or precalculus
  • Placement messaging should be done once with single recommendation and specifically state recommended course(s)
– Collaboration between high schools and colleges has increased
Adapting MMAP to AB 705

It’s all about throughput. #MaximizeThroughput
Adapting MMAP to AB 705

• MMAP decision trees were based on identifying students who were highly likely to be successful
  — At least 70% probability of success in transfer-level

• Now, students can only be assigned to remediation if:
  — They are highly unlikely to succeed at the transfer-level class
  — AND
  — Remediation maximizes their probability of throughput
Perceptions of Probability

Almost Certainly
Highly Likely
Very Good Chance
Probable
Likely
We Believe
Probably
Better Than Even
About Even
We Doubt
Improbable
Unlikely
Probably Not
Little Chance
Almost No Chance
Highly Unlikely
Chances Are Slight

Assigned Probability

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

What is a “Throughput Rate”?

• The probability of getting to and through a gateway course within a specified period of time.

• Throughput rate (AB 705): The proportion of a cohort of students who complete the transferable or gateway math or English course within two primary semesters or three primary quarters of entering their first course in the sequence.
### Transfer-Level English Throughput Rates

<table>
<thead>
<tr>
<th>11th grade GPA &lt; 1.9</th>
<th>11th grade &gt;=1.9 and D or worse in 11th grade English</th>
<th>11th grade &gt;=1.9 and C- or better in 11th grade English</th>
<th>11th grade GPA &gt;=2.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 43% pass rate</td>
<td>- 49% pass rate</td>
<td>- 62% pass rate</td>
<td>- 80% pass rate</td>
</tr>
<tr>
<td>- ~10% of students</td>
<td>- ~5% of students</td>
<td>- ~23% of students</td>
<td>- ~62% of students</td>
</tr>
</tbody>
</table>


English students with < 1.90 high school GPA
Starting at transfer-level: 7,294
Starting one-level below: 13,241
Maximizing Throughput: English

11th grade GPA < 1.9

- 43% pass rate
- ~10% of students

One-year English throughput rate by placement level for students with less than a 1.9 high school GPA

- Transfer-level: 43%
- One-level below: 12%
- Two-levels below: 2%
- Three-levels below: 0%
- Four-levels below: 0%
Identifying the Intent Cohort

Ed. Goals of Students Starting at One-level below in Math

Terminal AA/AS, Certificate, etc. (11.6%)
Statistics
Decision Tree

- HS_11_GPA_CUM >= 2.3
  - Node 7
    - PRE_CALC_UP11_C >= 0.5
      - Node 8
        - ALG_II_UP11_C >= 0.5
          - Node 10
            - 0.49 (10%)
          - Node 11
            - 0.58 (19%)
        - Node 9
          - 0.7 (4%)
    - Node 12
      - 0.4 (12%)
  - Node 11
    - HS_11_GPA_CUM >= 3
      - Node 1
      - Branch
      - Internal Node/split
        - HS_11_GPA_CUM >= 3.3
          - Node 2
            - PRE_CALC_UP11 >= 0.5
              - Node 4
                - 0.7 (16%)
              - Node 5
                - 0.81 (8%)
            - Node 6
              - 0.7 (16%)
          - 0.88 (30%)
      - Terminal node/leaf
        - Probability of success
        - Percent of students in leaf

Root Node

- Branch
- Internal Node/non leaf

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## Statistics Throughput Rates

### AB 705 Analysis of Pass Rates of Groups of Students in Transfer-level Statistics

<table>
<thead>
<tr>
<th>11th grade GPA &lt; 2.3</th>
<th>11th grade GPA&gt;=2.3 and C- or worse in Algebra II</th>
<th>11th grade GPA&gt;=2.3 and C or better in Algebra II</th>
<th>11th grade GPA&gt;=2.3 and C or better in Pre-Calculus</th>
<th>11th grade GPA &gt;=3.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 40% pass rate</td>
<td>• 49% pass rate</td>
<td>• 58% pass rate</td>
<td>• 70% pass rate</td>
<td>• 80% pass rate</td>
</tr>
<tr>
<td>• ~12% of students</td>
<td>• ~10% of students</td>
<td>• 12% of students</td>
<td>• ~4% of students</td>
<td>• ~62% of students</td>
</tr>
</tbody>
</table>


Statistics students with < 2.30 high school GPA
Starting at transfer-level: 1,485
Starting at one-level below: 11,309
Maximizing Throughput: Statistics

One-year Math throughput rate by placement level for students with less than a 2.3 high school GPA

- 40% pass rate
- ~12% of students
Variability by College for Statistics

- Variability in success and throughput rates exists among colleges
- Interest in determining if there are colleges where below transfer level remediation results in throughput rates that exceed direct placement
- We examined college variability for statistics comparing direct placement into statistics vs. throughput from one level below for students with HS GPA < 2.3
- Throughput rates adjusted *upward* to factor out those not seeking transfer and not on a statistics/liberal arts math (SLAM) path
- Matched these throughput rates with success rates of similar students placed directly into transfer-level statistics to create a direct placement delta statistic
  - I.e., the success rate when placed directly in stats minus the throughput rate from one level below.
  - Values > 0 mean students are more likely to complete statistics when placed directly
  - Colleges with fewer than 20 cases excluded
Direct Placement Delta by College for Statistics

- In no college was the throughput rate greater than the success rate when placed directly into transfer level.
The BSTEM ‘Intent Cohort’

• Which students intend to pursue a calculus-oriented Business-STEM math pathway from one-level below?

• Some students have a goal of a terminal associate’s degree and one-level below satisfies their requirement

• Some students intend to pursue a Statistics or Liberal Arts Math pathway

• How to distinguish intent?
The BSTEM ‘Intent Cohort’

• Remove those with a non-transfer educational goal (11.6%)
• Remove those on the SLAM path
  – Of those who progress to transfer-level math, 75% take SLAM vs. Precalculus, Calculus, Trig., or Business Calculus
  – Reduce remaining one-level below starting cohort by 75%
• Product of this process is the BSTEM intent cohort
  – This will be the denominator for BSTEM throughput rates
  – The denominator is reduced to 3,200 from 14,478
Figure 5. Pre-Calculus – LO Y Pre-Calculus DM

- **HS_11_GPA_CUM >= 3.1** (yes)
- **HS_11_GPA_CUM >= 2.6**
  - **PRE_CALC_UP11 >= 0.5**
    - 0.38 (16%)
    - 0.49 (5%)
  - **CALC_UP11 >= 0.5**
    - 0.55 (34%)
    - 0.72 (2%)
- **HS_11_GPA_CUM >= 3.4**
  - **CALC_UP11_BMINUS >= 0.5**
    - 0.67 (21%)
    - 0.76 (20%)
    - 0.94 (3%)
## Pre-Calculus Throughput Rates

### AB 705 Analysis of Groups of Students in Precalculus

<table>
<thead>
<tr>
<th>GPA Range</th>
<th>Pass Rate</th>
<th>Students %</th>
</tr>
</thead>
<tbody>
<tr>
<td>11th grade GPA &lt; 2.6 and no Precalc. in HS</td>
<td>38%</td>
<td>~16%</td>
</tr>
<tr>
<td>11th grade GPA &lt; 2.6 with Precalc. in HS</td>
<td>49%</td>
<td>~5%</td>
</tr>
<tr>
<td>11th grade GPA &gt;= 3.1 and &lt; 3.4</td>
<td>67%</td>
<td>~21%</td>
</tr>
<tr>
<td>11th grade GPA &gt;= 3.4</td>
<td>78%</td>
<td>~23%</td>
</tr>
</tbody>
</table>


Pre-calculus students with < 2.60 high school GPA
Starting at transfer-level: 1,753
Starting at one-level below: 18,917
Pre-Calculus Lowest Node

- 3,200 students with < 2.6 HSGPA and no precalculus in high school by grade 11 began at one-level below transfer math with intent to pursue a BSTEM path
  - 1,035 attempt a BSTEM class within one year (32.3%)*
  - 453 are successful in any BSTEM class, including College Algebra (14.2%)
- Throughput from one-level below into BSTEM is 14.2%
- If placed directly into Precalculus, throughput is 38%
Maximizing Throughput: Pre-Calculus

One-year BSTEM throughput rate by placement level for students with less than a 2.6 high school GPA and no HS precalculus

- 38% pass rate
- ~16% of students

11th grade GPA < 2.6 and no Precalc. in HS
Exploring the “Double Placement” Bias

- Differences in HS GPA, test scores, and other factors exist among students at different placement levels.
- If a low HS GPA student who would have previously been placed into below transfer level is allowed direct access to transfer level course, what are the expected success rates compared to throughput rates from remedial sequences?
- Using success rate predictions from the MMAP decision-tree analyses may not fully account for letting “weaker” students into transfer level.
- We examine this issue for college composition, statistics, and precalculus focusing on the lowest node of each decision tree.
Adjusting Projected Success Rates

• Difference in GPA and placement test score can be statistically accounted for and the projected success rates of students from lower placement levels can be adjusted (lowered)

• The magnitude of the adjustment depends on:
  – the extent of the differences in test scores and GPA between those in the MMAP models and those who would potentially be entering via the decision rules, and;
  – the strength of the association between the test scores/GPA and success in the target class
HS GPA (through 11th grade) for Students Taking CC English

Levels Below Transfer

Levels: -4, -3, -2, -1, 0

Density

High School GPA Through 11th Grade

0.0
0.2
0.4
0.6

0
1
2
3
4

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Technical Details of Adjustment Process

• Use multivariate regression to predict success rate in target transfer-level using GPA and test scores
• Gaps in predicted success rates among five placement levels are fitted to observed success rates to preserve proportionality
• Relative gaps are applied to the original PPV and predicted success rates for students from each level are derived
• A weighted average based on number of students at each level who would be affected is calculated to yield overall adjusted predicted success rate
Regression Models

• **English**
  – Success Indicator = HS GPA + ACCUPLACER sentence skills score + ACCUPLACER reading comprehension score
  – Weakest model ($R^2=0.011$) with sentence skills not significant

• **Statistics and Precalculus**
  – Success Indicator = HS GPA + ACCUPLACER college algebra score
  – Stronger yet still modest models ($R^2=0.10$ for statistics; $R^2=0.09$ for precalculus)
  – Other test scores (arithmetic and elementary algebra) for statistics did not yield useful results so only college algebra was used
Regression Adjusted Success Rates

(error bars represent ±1 se)
Putting it all together:
Multiple Measures and Corequisite Support

Mathematics at Cuyamaca College

- Disjunctive placement (higher of test-based or MM-based placement – adapted f/Phase 1 MMAP
  - *Algebra I* with C or better plus HSGPA ≥ 2.8: **Statistics with corequisite support**
  - *Algebra II* with C or better and HSGPA ≥ 2.8: **College algebra or higher w/corequisite support**
  - Other MMAP placement recommendations for higher placement without support

English at Skyline College

- Phased transition over three years
  - Accelerated developmental education at one level below
  - Then, MMAP implementation of English placement recommendations and corequisite developmental education courses


For more, please see recent publications by the California Acceleration Project:
Gateway momentum in Math at Cuyamaca

Completion of transfer-level math before and after change by assessment level

<table>
<thead>
<tr>
<th>Assessment Level</th>
<th>Fall 2013 Cohort</th>
<th>Fall 2016 Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three+ Levels Below</td>
<td>4%</td>
<td>56%</td>
</tr>
<tr>
<td>Two Levels Below</td>
<td>19%</td>
<td>70%</td>
</tr>
<tr>
<td>One Level Below</td>
<td></td>
<td>66%</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>67%</td>
</tr>
</tbody>
</table>

- Fall 2013 Cohort (Transfer Math in 2 years)
- Fall 2016 Cohort (Transfer math completion 1 semester w/support)
Gateway momentum in English at Skyline

English placement by level and cohort

- Transfer-Level: 80% (Fall 2016) vs. 47% (Fall 2013)
- One Level Below: 40% (Fall 2016) vs. 3% (Fall 2013)
- Two Levels Below: 17% (Fall 2016) vs. 14% (Fall 2013)

Successful rate by cohort and course type

- Fall 2013: 67% (Transfer Level (f/Datamart))
- F2015-S2017: 65% (traditional)
- F2015-2017: 69% (w/support)
Percent of Remedial Students Who Complete an Associated Gateway Course

(In two years for prerequisite models, in first year for corequisites)

Successful completion within 1 year vs. corequisite results by testing level - TN

Results of TBR Full Implementation Co-requisite Writing in Community Colleges

<table>
<thead>
<tr>
<th>Level</th>
<th>Pre-requisite Model AY 2012-13</th>
<th>Co-requisite Full Implementation AY 2015-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=13</td>
<td>25.3%</td>
<td>53.9%</td>
</tr>
<tr>
<td>14</td>
<td>27.8%</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>33.2%</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>36.9%</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>37.8%</td>
<td></td>
</tr>
<tr>
<td>No ACT</td>
<td>25.1%</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>61.8%</td>
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Results of TBR Full Implementation Co-requisite Mathematics in Community Colleges

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</tr>
</thead>
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<tr>
<td>&lt;=13</td>
<td>2.7%</td>
<td>32.9%</td>
</tr>
<tr>
<td>14</td>
<td>3.8%</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>6.8%</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>11.5%</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>19.7%</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>25.6%</td>
<td></td>
</tr>
<tr>
<td>No ACT</td>
<td>13.1%</td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>54.8%</td>
<td></td>
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What should the standard of comparison be?

**Mathematics**

- Throughput (f/1 level below): 10%
- Direct Placement (adjusted): 29%
- Cuyamaca Coreq >3 levels below: 56%
- Tennessee Coreq <13 ACT: 33%

**English**

- Throughput (f/1 level below): 12%
- Direct Placement (adjusted): 39%
- Cuyamaca Coreq >3 levels below: 69%
- Tennessee Coreq <13 ACT: 54%
Summary for AB 705

• Moderate to high performing high school students must be placed directly into transfer-level courses by law.

• Evidence to date suggests that even lowest performing HS students are more likely to complete transfer-level English & math (Statistics for SLAM, PreCalculus for STEM students with HS intermediate algebra) if placed there directly
  – compared to if placed in a developmental education sequence
  – especially if provided concurrent support

• To use alternative, colleges must show that students will be more likely to complete transfer-level courses within one year
## Placement/Support Recommendations for English

<table>
<thead>
<tr>
<th>High School Performance</th>
<th>AB 705-Compliant Placement</th>
</tr>
</thead>
</table>
| HSGPA ≥ 2.6             | Transfer-Level English Composition  
                          | No additional academic or corequisite support required |
| HSGPA 1.9 - 2.6         | Transfer-Level English Composition  
                          | Additional academic and corequisite support recommended |
| HSGPA < 1.9             | Transfer-Level English Composition  
                          | Additional academic and corequisite support strongly recommended |

For students with high school transcripts within 10 years of enrollment at CC, excluding students who are locally advised to take the ESL test.
## Placement/Support Recommendations for Statistics

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<th>High School Performance</th>
<th>AB 705-Compliant Placement</th>
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<tbody>
<tr>
<td>HSGPA ≥ 3.0</td>
<td>Transfer-Level Statistics</td>
</tr>
<tr>
<td><strong>Or</strong></td>
<td></td>
</tr>
<tr>
<td>HSGPA ≥ 2.3 &amp; C or</td>
<td>No additional academic or corequisite support required</td>
</tr>
<tr>
<td>Better in Precalculus</td>
<td></td>
</tr>
<tr>
<td>HSGPA 2.3–3.0</td>
<td>Transfer-Level Statistics</td>
</tr>
<tr>
<td></td>
<td>Additional academic and corequisite support recommended</td>
</tr>
<tr>
<td>HSGPA &lt; 2.3</td>
<td>Transfer-Level Statistics</td>
</tr>
<tr>
<td></td>
<td>Additional academic and corequisite support strongly recommended</td>
</tr>
</tbody>
</table>

For students with high school transcripts within 10 years of enrollment at CC.
# Placement/Support Recommendations for Statistics

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</thead>
<tbody>
<tr>
<td>HSGPA ≥ 3.0 Or HSGPA ≥ 2.3 &amp; C or Better in Precalculus</td>
<td>Transfer-Level Statistics No additional academic or corequisite support required</td>
</tr>
<tr>
<td>HSGPA 2.3–3.0</td>
<td>Transfer-Level Statistics Additional academic and corequisite support recommended</td>
</tr>
<tr>
<td>HSGPA &lt; 2.3</td>
<td>Transfer-Level Statistics Additional academic and corequisite support strongly recommended</td>
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For students with high school transcripts within 10 years of enrollment at CC.
Discussion
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