Evaluation of MMAP Placement at CRC

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Math MMAP Evaluation Summary

The ongoing evaluation of MMAP at Cosumnes River College (CRC) has two primary focus areas: (1) discerning the impact of higher placement through multiple measures (as compared to an assessment test) and (2) describing the predictive contribution of an assessment test (if any) when used in conjunction with the MMAP model. There are two justifications for these focus areas. First, the MMAP system was developed on a very large sample of students *who had already been placed by an assessment test*. Therefore, there is a possibility that the predictive capacity of the model may diminish for students that were not placed into a course by an assessment test (e.g., students that received an increase in placement relative to their assessment test). Second, a study by ACT found that high school GPA and an assessment test were stronger predictors of course success than GPA alone (Westrick & Allen, 2014).

Modification Strategy and Original Model

The original MMAP rules for placement can be found in *Table 1* below. Modifications of the system at CRC focused on high school prerequisite courses proposed in the MMAP model. The rules for direct and non-direct matriculants were developed from large sample analyses, and therefore, were left unchanged. On the other hand, the prerequisite courses for each level were added out of concern that the model alone could place students into a level without required knowledge to succeed. For example, without the high school prerequisite course of trigonometry/pre-calculus, a student could place into calculus with a 3.6 GPA alone. These prerequisite rules were not validated through MMAP research findings, and therefore, were modified on the basis of pilot findings at CRC.

Note that the pilot at CRC did not use MMAP rules related to the California Standardized Test (CST). These data were not readily available at the time of the pilot.

Table 1. MMAP transcript placement rules (excluding rules for CST)

Level Name	High School Prerequisite	Direct Matriculant Rules	Non-Direct Matriculant Rules
Calculus	Passed Pre-Calculus or Trig (or higher)	HS 11 GPA >= 3.6 HS 11 GPA >= 3.2 and Pre-Calculus C (or better)	HS 12 GPA >= 3.1 and Calculus HS 12 GPA >= 3.5
Pre-Calculus	Passed Algebra II (or higher)	HS 11 GPA >= 3.4 HS 11 GPA >= 2.6 and Calculus	HS 12 GPA >= 3.3 HS 12 GPA >= 3 and Algebra II CST >= 340 HS 12 GPA >= 3 and Calculus C (or better)
Trigonometry	Passed Algebra II (or higher)	HS 11 GPA >= 3.4 HS 11 GPA >= 3 AND Pre-Calc C+ (or better) HS 11 GPA >= 3 AND Alg II B (or better)	HS 12 GPA >= 3.3 HS 12 GPA >= 2.8 and Pre-Calculus C (or better)

College Algebra	Passed Algebra II (or higher)	HS 11 GPA >= 3.2 HS 11 GPA >= 2.9 and Pre-Calculus C (or better)	HS 12 GPA >= 3.2 HS 12 GPA >= 3.0 and Pre-Calculus or Statistics (with C or better)
General Education Math	Passed Algebra II (or higher)	HS 11 GPA >= 3.3	HS 12 GPA >= 3.2 HS 12 GPA >= 2.9 and Statistics C (or better)
Statistics	Passed Algebra I (or higher)	HS 11 GPA >= 3.0 HS 11 GPA >= 2.3 AND Pre-Calculus C (or better)	HS 12 GPA >= 3.0 HS 12 GPA >= 2.6 AND Pre-Calculus C (or better)
Algebra II	Passed Algebra I (or higher)	HS 11 GPA >= 2.8	HS 12 GPA >= 2.9 HS 12 GPA >= 2.5 and Algebra II CST >= 302 HS 12 GPA >= 2.5 and Pre-Calculus C (or better)
Algebra I	No minimal HS requirement	HS 11 GPA >= 2.4	HS 12 GPA >= 2.5 HS 12 GPA >= 2.0 and Algebra I CST >= 302 HS 12 GPA >= 2.3 and Algebra II C (or better)
Pre-Algebra	No minimal HS requirement	HS 11 GPA >= 2.0	HS 12 GPA >= 2.1 HS 12 GPA >= 1.6 and Algebra 1 Cluster 1 >= 8
Arithmetic	No minimal HS requirement	All Others	Everyone Else

Fall 2016 Pilot: Brief Summary of findings and ruleset modifications

Summary of findings

The initial pilot of the MMAP system at CRC was conducted with a First Year Experience (FYE) cohort. High school transcripts were evaluated manually, and 141 students received an MMAP placement. The original MMAP model (*Table 1*) was used for placement in this cohort. Students were asked to enroll in the highest of their assessment test (Compass) or MMAP placement. Out of this initial cohort, a total of 129 FYE students ultimately enrolled in math in Fall 2016.

The overall success rate in math for the MMAP pilot was 46.5%. This rate was lower than that of a comparison cohort of first-time students taking math in Fall 2016 (51.4%). The lower success rate for the FYE cohort was explained in part by below-transfer students who received an increase in placement as a result of the MMAP system. Students who enrolled one-level higher than their Compass placement succeeded at a 25% rate, and students who enrolled two or more levels higher succeeded at a 12.5%

rate (*Table 2*). These success rates were low, but the sample sizes were too small to draw any definitive conclusions. Finally, it should be noted that transfer-level students who received an increase in placement had a success rate of 55.6%, but the sample size was very small (*N* = 9).

Table 2. Success rates for students who increased placement

Placement Group	Total	Success Rate
Compass/MMAP the same	27	55.6%
MMAP 1 Level Above Compass	16	25.0%
MMAP 2+ Levels Above Compass	8	12.5%
All students in an MMAP Course above	**24**	**20.8%**

Model Modifications

The sample size from the pilot was too small to draw any definitive conclusions. However, given that second wave of piloting would impact more students, the math department at CRC decided to add two precautionary modifications. Algebra 1 with a "C" or better was added as a pre-requisite to the algebra 1 and pre-algebra levels (*Table 3*) with the hopes of preventing large increases in placement on the basis of GPA alone. For example, a student who placed into arithmetic could move two levels higher with a 2.4 GPA.

Table 3. MMAP transcript placement rule modifications

Level Name	High School Prerequisite	Direct Matriculant Rules	Non-Direct Matriculant Rules
Algebra I	Passed Algebra I (or higher)	HS 11 GPA >= 2.4	HS 12 GPA >= 2.5 HS 12 GPA >= 2.0 and Algebra I CST >= 302 HS 12 GPA >= 2.3 and Algebra II C (or better)
Pre-Algebra	Passed Algebra I (or higher)	HS 11 GPA >= 2.0	HS 12 GPA >= 2.1 HS 12 GPA >= 1.6 and Algebra 1 Cluster 1 >= 8

Fall 2017 Pilot: Brief summary of initial findings and rule set modifications

Summary of Findings

The initial evaluation of the Fall 2017 pilot focused on student drops in the first few weeks of class (prior to census) and withdraws ("W" grades) after census. The pilot involved 434 students who had received an MMAP placement. Note that students were placed with the slightly modified MMAP rules described in the previous section. A total of 248 were enrolled as of the first day of classes in Fall 2017. The evaluation had two aims:

1) Evaluate pre-census drops in transfer-level. Anecdotal reports from instructors of calculus indicated that many students in the FYE program dropped pre-census. Anecdotal reports should not be used as evidence for placement errors, but these reports can be used to generate hypotheses.
2) Replicate (or reject) the findings from the first evaluation. Specifically, the first pilot found that below-transfer students who received a higher placement from the MMAP system had a lower likelihood of success. The first pilot also found that students in transfer-level who received a higher placement did not have a lower likelihood of success.

With regards to the first aim, the investigation focused on pre-census drop rates for pilot students that were enrolled on the first day of class. Students were divided into three groups: students enrolled in their Accuplacer placement (the *Accuplacer* group), students enrolled in their MMAP placement (the *MMAP* group), and students enrolled in a course where their Accuplacer/MMAP placement were the same (the *Same* group). Enrollment course levels were coded into continuous values for the sake of analysis – from level 0 (*Arithmetic*) to level 6 (*Calculus*). Analysis revealed that, within the MMAP group, students who placed higher were more likely to drop pre-census ($t(1) = 3.49$, $p < .001$)[1]. This increase in likelihood was entirely driven by placement into calculus. Nearly all of the students who placed into calculus with the MMAP model dropped pre-census (71.4%), but the sample size in calculus was *extremely* small (5 students dropped out of 7 placed).

With regards to the second aim, withdraw rates ('W' grades) were evaluated after the last day to drop courses. Enrollment levels were again coded into continuous values from level 0 (*arithmetic*) to level 6 (*calculus*). Analysis revealed that for students who assessed into Math 20 or 30 (via Accuplacer) the chance of withdraw significantly increased for each level increase from the MMAP system ($t(1) = 2.96$, $p < .01$ and $t(1) = 2.44$, $p < .05$, respectively)[2]. The projected probability by Math 20/30 placement level are presented below (*Table 4*). A student who placed into Math 20 via Accuplacer would have a 17.6% chance of withdraw in Math 20 compared to a 66.5% chance if moved into Math 120/125. For students who assessed into Math 100 or higher, there was no significant change in the probability of withdraw for each level increase.

In summary, initial findings from the second (Fall 2017) pilot found that:

1) Students were more likely to drop pre-census if placed into calculus with the MMAP system. However, sample sizes were extremely small for students placed into calculus.
2) Students who were placed into Math 20 or 30 (via Accuplacer) were more likely to withdraw with each level increase provided through the MMAP system. Students who placed into Math 100 or higher did not exhibit the same trend. These findings provide partial replication to the findings from the CRC pilot in Fall 2016.

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[1] Data were analyzed with logistic regressions, assuming quasi-binomial error. The interaction between student group and the continuous course level variable was significant, $F(2) = 9.62$, $p < .05$.

[2] Data were again analyzed with logistic regressions, assuming quasi-binomial error. The interaction between Accuplacer assessment level and actual enrollment level was significant, $F(1) = 5.09$, $p < .05$.

Table 4. Projected probability of withdraw by enrollment level for students placed into Math 20/30 via Accuplacer

	Assessment Level	
Enrollment Level	**Math 20**	**Math 30**
0 (Math 20)	17.6%	
1 (Math 30)	31.0%	27.4%
2 (Math 100)	48.5%	38.2%
3 (Math 120/125)	66.5%	50.5%
4 (Math 335, Stat 300)	80.7%	62.6%
5 (Math 370)	89.8%	73.3%
6 (Math 400)	94.9%	81.9%

Note. Courses in parentheses are not exhaustive lists of the courses in each enrollment level.

Model Modifications

The results were presented to the math chair at CRC, and several modifications to the model were made. First, the top two levels of the model were removed, such that students could not place into pre-calculus/calculus via MMAP placement. This decision was made on the basis of a converging piece of evidence. Specifically, a qualitative review of the curriculum in the Elk Grove Unified School District (EGUSD) revealed that the pre-calculus curriculum does not cover trigonometry, and calculus at CRC is heavily trigonometry focused. Therefore, students may have been placed into calculus without prerequisite knowledge resulting in high pre-census drop rates. Second, additional changes to the high school prerequisites were added in order to prevent large moves from students in Math 20/30. For both Math 20 and 30, the projected probability of withdraw increases above 50% at the 120 level, therefore the pre-requisite high school coursework for algebra II placement was changed to algebra 1 with a B or better. Additionally the prerequisites for trigonometry and statistics were also changed to be more stringent. *Table 5* below summarizes all changes to prerequisites across both pilots (Fall 2016/2017).

Table 5. Summary of Prerequisite Changes

Level Name	High School Prequisite (old)	High School Prequisite (current)
Trigonometry	Passed Algebra II (or higher)	Passed Algebra II (B or Better)
Statistics	Passed Algebra I (or higher)	Passed Algebra II (or higher)
Algebra II	Passed Algebra I (or higher)	Algebra I (B or Better)
Algebra I	No minimal HS requirement	Passed Algebra 1

Pre-Algebra	No minimal HS requirement	Passed Algebra 1
Arithmetic	No minimal HS requirement	No minimal HS requirement

Limitations and Future Directions

With regards to both evaluations at CRC, the primary limitation was sample size. Various factors limited the sample of our investigations – from implementation speed to lack of student enrollment. We attempted to ameliorate the bias of small sample sizes by replicating findings across both pilots. However, future investigations may contradict the findings reported here. Continued evaluation is therefore essential to implementing multiple measures at CRC. Additionally, for the purposes of providing timely data, we focused on withdraw rates to inform the second round of model modifications. Withdraw rates are correlated with course success rate, but may be an imperfect measure of overall course success for the Fall 2017 pilot. As such, a follow-up analysis will be conducted once the final grade snapshot is available.

Finally, several modifications to the system require further discussion and evaluation. First, removing the calculus/pre-calculus placement level from the MMAP model at CRC may require further consideration. A less extreme approach would have been to require high school trigonometry as a prerequisite. Trigonometry is sometimes offered in EGUSD high schools, and therefore, some students would have a chance to place into calculus on the basis of their high school transcript. Second, changing the trigonometry and statistics high school prerequisite may have been too extreme. The modification of the high school prerequisites focused on preventing large moves from students who assessed (via Accuplacer) into Math 20. However, only 6 out of 97 Math 20 students (6.2%) received an increase into statistics/trigonometry. The change in prerequisites may prevent this type of movement, but it may also prevent prepared students from entering transfer-level.

Future evaluations should focus on maximizing the probability of transfer-level progression and completion. A focus or emphasis on transfer-level progression would de-emphasize slight decreases in course success rates. For example, if a particular student was placed at the bottom of a three course sequence, there are five potential stopping points (presuming the student enrolls). The student could fail any of the three courses (three chances) or fail to enroll in the next level of math after succeeding (two chances). Placing the student into the second level of the sequence would reduce the potential stopping points by two (one course and one enrollment). In this case, a decrease in the probability success in the second level of the sequence could be offset by an increase in the probability of progression and completion. Nevertheless, a large decrease in the probability of success could result in a detriment to progression and completion.