

## **UCSC Advising for Math Placement and Course Selection Summer, 2017**

Representatives of the Divisions of Student Success, Undergraduate Education and Physical and Biological Sciences; and the Departments of Mathematics and Applied Mathematics and Statistics met over the last few months to discuss math placement, college algebra and precalculus courses, and student success. These discussions resulted in agreements which are important to share with advisers so that communications across campus are consistent.

### **Research on ALEKS PPL**

ALEKS PPL is the tool UCSC uses to place students who haven't placed otherwise (previous coursework or AP or IB scores). ALEKS PPL is a multi-stage process of assessment and improvement – it is not an online exam.

As an *adaptive learning* tool, ALEKS PPL identifies the specific gaps in students' learning and then targets lessons to those specific topics. Students who only need to refresh and reinforce some parts of the college algebra or precalculus curriculum, will save money and time (without negatively affecting their success) by fully utilizing ALEKS PPL to review material and reassess. Six out of seven students who reassess will advance to a higher tier. That is, they will be able to take a higher math course than they would have given their initial placement.

Research shows that since ALEKS PPL was implemented as UC Santa Cruz's Math Placement tool in 2015, more students are getting into more advanced classes without endangering their academic success. For example, the year we began using ALEKS PPL, the yearly enrollment in MATH 2 (College Algebra for Calculus) dropped by *half*, from more than 800 to fewer than 400, and yet pass rates in all the relevant math courses remained roughly the same.

Initial research also shows that students who used ALEKS PPL to “work their way up” into MATH 3 (Pre-Calculus), MATH 11A/11B (Calculus with Applications), or MATH 19A/19B (Calculus for Science, Engineering and Mathematics) did as well as those who placed into the same courses from the start, once other factors known to affect performance were taken into account. They had comparable grades and pass rates, and perhaps most importantly, comparable grades in the next math course they took.

Research also shows that enrolling in a course lower than the recommended Math Placement (MP) ALEKS PPL tier may not benefit a student. If a student has reassessed at least twice and still is scoring in the MP 200 tier, AMS 3 or MATH 3 is appropriate. However, the effectiveness of a strategy of taking MATH 3 as a comfortable course or to boost one's grade in calculus has not been borne out by data thus far. Students who are calculus-eligible (in the MP 300 tier or above), don't do better overall in MATH 3 than those who aren't yet calculus-eligible. In fact, research nationally suggests that universities may be hindering student success by placing too many students into remedial courses.

## Scores, Tiers, and Reassessment

A student's best ALEKS PPL diagnostic score and intended major determines the appropriate class for the student. The ALEKS PPL score is the percentage of the total "knowledge space" (up through precalculus material) that ALEKS estimates the student has mastered; it is not determined by the number of correct answers given by the student. The ALEKS PPL score is [converted](#) to a UCSC placement tier (100-500) for placement purposes.

Students can review material in their ALEKS [Learning Module](#) and then reassess (up to four times). UCSC requires a minimum of 5 hours of review and a 48 hours "cooling off period" between assessments. Research shows improvement by students who reassess after as little as the minimum required 5 hours of review before reassessment.

A student's *best* ALEKS PPL score determines their placement tier. If a student improves their placement by reassessing, any earlier placement results become inoperative. An improved placement tier should not be discounted in any way—reduced stress, increased familiarity with ALEKS and its atypical assessment protocol, and precisely targeted review result in dramatic improvements for many students.

It is essential that advisers reinforce students' confidence in their placement; this is particularly important for URM and EOP students. Some URM students worry that they'll be suspected of cheating<sup>1</sup> if there's "too much" improvement between assessments, but given the mechanisms of [stereotype threat](#), students belonging to groups associated to negative stereotypes regarding mathematical ability are particularly likely to benefit from reduced stress in assessment.

Students who haven't reached their desired placement tier before their enrollment window opens should be encouraged to enroll in the math course that they're currently eligible for, and assisted in designing a schedule that will accommodate a move to a more advanced math course if they improve their placement before the start of the term.

## Tiers: Reassessment Outcomes and Enrollment Options

- o Students who initially place below the MP 300 tier should be urged to use their ALEKS Learning Module and then reassess<sup>2</sup>.

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<sup>1</sup> Some cheating undoubtedly occurs, but ALEKS probes in depth if it detects atypical patterns of expertise, so looking up a half recalled trig identity is unlikely to significantly skew the outcome.

<sup>2</sup> Reassessing not only enables students to enroll in classes that meet graduation requirements, it also helps those students for whom MATH 2 or 3 or AMS 3 is appropriate by reducing class size and increasing the ratio of teacher/TAs to students, which will tend to improve student success.

- o Of those who initially place in the MP 100 tier and reassess:
  - 6 out of 7 students improve their placement by at least 1 tier;
  - Nearly 2/3 become calculus-eligible and satisfy the math requirement for Psychology majors; and
  - Nearly half become eligible for MATH 19A.

Students who remain in the MP 100 tier after reassessing should enroll in MATH 2 (or 2T).

- o Of those who initially place in the MP 200 tier and reassess:
  - 20 out of 21 students improve their placement by at least 1 tier, becoming calculus-eligible and satisfying the math requirement for Psychology majors.
  - 6 out of 7 students become eligible for MATH 19A.

Students who remain in the MP 200 tier after reassessing should enroll in AMS 3 or MATH 3.

- o Students in MP tier 300 or higher are eligible to enroll in one or more of the calculus<sup>3</sup> sequences:
  - 300 tier: AMS 11A or MATH 11A;
  - 400 tier: the above or MATH 19A;
  - 500 tier: the above or MATH 20A.

Students who initially place in the 300 tier who need MATH 19A for their major should use their ALEKS Learning Module and reassess; 93% become eligible to enroll in MATH 19A on reassessment.

Students in the 300 or 400 tier who wish to take MATH 20A should also review and reassess; 1/3 of the students starting in the 300 tier and 2/3 of those starting in the 400 tier advance to the 500 tier. Students should understand that MATH 20A-B are highly conceptual, proof based treatments of calculus, and they are not the default option even for students with very high placement scores.

### **MATH 3 vs. AMS 3**

Students in the STEM fields with a best score in the MP 200 tier should enroll in MATH 3, whereas students who intend to major in the humanities, social sciences, or the arts with a best score in the MP 200 tier should enroll in the redesigned AMS 3 (Precalculus for the Social Sciences) - an exception is students who intend to major in economics; the Economics Department advises students to begin with MATH 3. MATH 3 is designed to prepare students for calculus, while AMS 3 emphasizes mathematical modeling of

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<sup>3</sup> The Math Coach site [Course Guide](#) contains the table of contents for the texts currently used for three of the [calculus sequences](#): AMS 11AB, MATH 11AB and 19AB. Other information such as sample homework, exams, etc. will be added soon.

problems in the social sciences.

### **Fulfilling the Mathematics and Formal Reasoning (MF) General Education Requirement**

MATH 3 is intended to provide students with the basic skills and knowledge needed for calculus; it is not designed to expose students to the versatility, power, and appeal of mathematical reasoning and structure. Students in non-STEM, non-Psychology majors should be encouraged to take courses other than MATH 3 to satisfy the MF GE requirement. Other courses that meet the MF requirement are listed [here](#).

Roughly half of the students who take MATH 3 have already placed into calculus eligibility; reviewing familiar, prosaic material is antithetical to the intent of the GE requirements. It can also end up feeling discouraging to students. Students who truly need precalculus instruction suffer when classes are too large.

### **Continued research is important**

The working group agreed that ongoing analysis of data on students' ALEKS PPL scores and subsequent school work and outcomes is essential, to validate use of ALEKS PPL in Math Placement and ensure that the placement process promotes equitable outcomes. Therefore, researchers from UC Santa Cruz's Institutional Research, Assessment and Policy Studies (IRAPS) and Student Success Evaluation and Research Center will report on related data over time, including enrollments, reassessments, retention rates, grades, and demographics.

### **What the research means for advising**

- Students who initially score below the MP 300 tier, or below eligibility for the appropriate calculus sequence for their major, should be urged to practice in their ALEKS Learning Module and reassess.
- Non-STEM (intended) majors who place in the MP 200 tier should take AMS 3, not MATH 3, with the exception of intended economics majors. Economics advisers may suggest some students take AMS 3 based on individual circumstances.
- Students who don't intend to continue in mathematics or science courses should consider using courses other than MATH 3 to fulfill the MF requirement.