University of Toledo
Ohio Math Initiative Results
MATH 1180 "Reasoning with Mathematics"
Results After Institution of Co-Requisite Labs

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The history and current UT plan for QR and co-requisite labs

Based upon recommendations of the Ohio Math Initiative we developed a QR course and piloted it alongside our Math for Liberal Arts (MLA) in Fall 2016. In Fall 2017 we replaced MLA by QR entirely and piloted co-requisite labs, intending them to be for less-well prepared students for half of the QR sections. In those sections, roughly 2/3 of the students were placed in a co-requisite lab. QR sections are capped at 35. In Fall 2018, many factors led us to place *all* QR students in co-requisite labs, with the option of testing out of the lab at certain demarcation points during the semester. Our current plan going forward is to keep students in the co-requisite lab throughout the semester. This helps in several ways, but a key one is how it facilitates the group work that is integral to the quantitative reasoning course.

Analysis of the Data:

1. I divided terms into three groups: before QR (BQR), and during (TQR) and after (AQR) the transition to QR with co-requisite for all students.
2. I computed equivalent ACT Math scores for all placement tools, including SAT Old, SAT New, ALEKS and our local College Algebra Placement test. To convert to ACT equivalent scores I used a linear regression fit to cutoff standards that we have employed for the last several years and more. Then I divided students into placement groups based on the average of whatever scores were available for that student (often just one of the five). Groups include those who we regarded as very underprepared (ACT equivalent 17 and below), underprepared (ACT 18 & 19), ready for our lowest level math (e.g. Statistics - 20 & 21), ready for the next level of math (e.g. Trigonometry – 22 & 23), ready for Pre-calculus (24, 25& 26), and ready for Calculus (27 and above).
3. Using UT and high school GPA's, those with no placement score (having none of the five scores) seemed to align most closely with our underprepared students.
4. Between passing rates (D- and up), success rates (C- and up), and grade on the 4 point scale, I have chosen to focus our analysis on success rate. Here are three reasons: 1) this seems to be where administrative attention focuses (on the converse DFW rate), 2) C- is our criterion for moving on to the next math course (though from QR there is no "next" math course), and 3) it includes "Withdraw", whereas the numeric grade treats "W" as missing data. In the table below, SR stands for Success Rate.

Results

ACT Group	N(BQR)*	SR(BQR)	N(TQR)	SR(TQR)	N(AQR)	SR(AQR)
NA	1487	63.7%	324	70.1%	171	67.2%
LE 17	2260	**52.5%**	446	60.8%	147	**66.0%**
18-19	1105	**65.1%**	179	71.5%	72	**84.7%**
20-21	707	74.3%	103	70.9%	33	78.8%
22-23	618	74.6%	88	80.7%	45	84.4%
24-26	605	81.0%	96	83.3%	40	87.5%
GE 27	199	84.4%	26	80.8%	14	92.9%

* N is the number of students involved. Data goes back to 2008, giving us large sample sizes for our Before QR (Math for Liberal Arts) group. I did not eliminate students repeating the course. Since MATH 1180 has no prerequisite courses, I did not eliminate students who had a previous math course at UT.

The primary result is that **success rate after QR is *higher than before* QR** for every ACT Group. For the ACT below 20 groups, the increase in success rate is largest, and is in the double digits. This indicates that the advent of QR, based entirely on the Ohio Math Initiative, has resulted in increased success. And the increase is higher for underprepared students. The ultimate proof of success of course will come after we examine retention and graduation for these students. We will hope that this math content, and success in learning it, will result in higher success at the university. We believe that success in the course should lead to a positive impact in eventual university success, especially since math has traditionally been regarded as a (the?) barrier.

Summary Statement:
A quantitative reasoning course has replaced our previous Math for Liberal Arts. Over the two years since partial, and one year since full, implementation in its current form (with two hour co-requisite labs), success rates have improved, particularly for ACT Math (or equivalent) groups below 20 where improvements in success rates ranged from 13.5% (ACT Math 17 and below) to 19.6% (Act Math 18 – 19).

University of Toledo
MATH 1320 College Algebra
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Percent Success	*No Previous UT Math Course*			*Overall*		
ABC / C- or better / non-DFW						
ACT(SAT) Group	**With CoReq**	**Without CoReq**	**Past**	**With CoReq**	**Without CoReq**	**Past**
Below 20	66.7	60.0	53.3	62.3	51.0	47.5
20-21	**75.0**	**72.7**	**53.9**	**73.6**	**69.4**	**51.5**
At Least 22	89.3	**75.3**	75.1	80.5	**71.3**	71.5
Missing	71.3	68.4	65.9	69.0	65.4	58.9

Historically at UT we have allowed students with ACT Math of 20 to take College Algebra, lower than the statewide standard of 22. Not surprisingly, this has led to low success rates. See the table on the left with the **red** highlights; the "past" success rate is 53.9% for this group. However, note that as we include students who have previously had some math class at UT, the success rate is even lower, 51.5%. This also could be expected since this would include those who have failed College Algebra. Note that these numbers compare poorly to the success rate of students with ACT Math 22 or higher – 75.1% for those with no previous UT math course and 71.5% overall. Students with ACT Math 20-21 have traditionally represented about 25% of the students taking with course. Past data is from Fall, 2013 when we switched to using ALEKS as an integral component of College Algebra.

Last year, in fall of 2018, our first try at a co-requisite model for this course was to offer sections with an additional two contact hour co-requisite lab (zero credit hours) to students in the 20-21 range. For 112 students, the success rate jumped to 75%, a very good result. As well as exceeding the prior success rate by over 20% additional percent, it caught them up with their peers with ACT Math at least 22 (75.3% success rate).

The confusing twist is that the same ACT group *without* the co-requisite lab also had a higher success rate, 72.7%. One point to consider, however, is that every effort was made to steer this group to the co-requisite labs. Some of those who did not end up there may have arrived at that choice (with their advisors) due to a high level of confidence in their ability to succeed in this class. Additionally, not being the recommended pathway, the size of this group was only 33. Hence the "success gap" from 53.9% to 72.7% represents only 6 students. If we test the statistical significance of this, we find the exact P-value is .035.

Results overall, considering all students in the course (table with **green** highlights; including those who), are similar – though with success rates a few percent lower. This is likely due to inclusion of students who previously failed college algebra.

We are encouraged by these results. We are so encouraged that this year we are piloting the extension of students recommended for the co-requisite labs down into the ACT Math 18-19 range. Data is not yet available, but midterm grades indicate (I am still gathering this information).

Note: Success in the next course will be valuable information we can acquire soon.

Summary Statement:
As of fall one year ago, co-requisite labs have been introduced in College Algebra for students in the ACT Math (or equivalent) range of 20 – 21. Results are positive. Focusing on students with no previous math course at UT (a previous course would supplant the ACT Math score), success rates increased by 21.1%. Further, the success rate for that ACT group (75%) is now comparable to that of students with ACT Math at least 22 (75.3%). The number of such students is 112. A caveat is that success rates also increased (by 18.8% to 72.7%) for students in the lower ACT range but who ended up in sections lacking the co-requisite labs. We hypothesize that students (a small number, n = 33) found themselves incorrectly in sections without co-requisite labs in a non-random fashion, convincing themselves or their advisors that the extra time in class was not required. Hence their ability or motivation may have been higher than indicated by their ACT math scores.