



Math Diagnostics and Relationship to Course Grades

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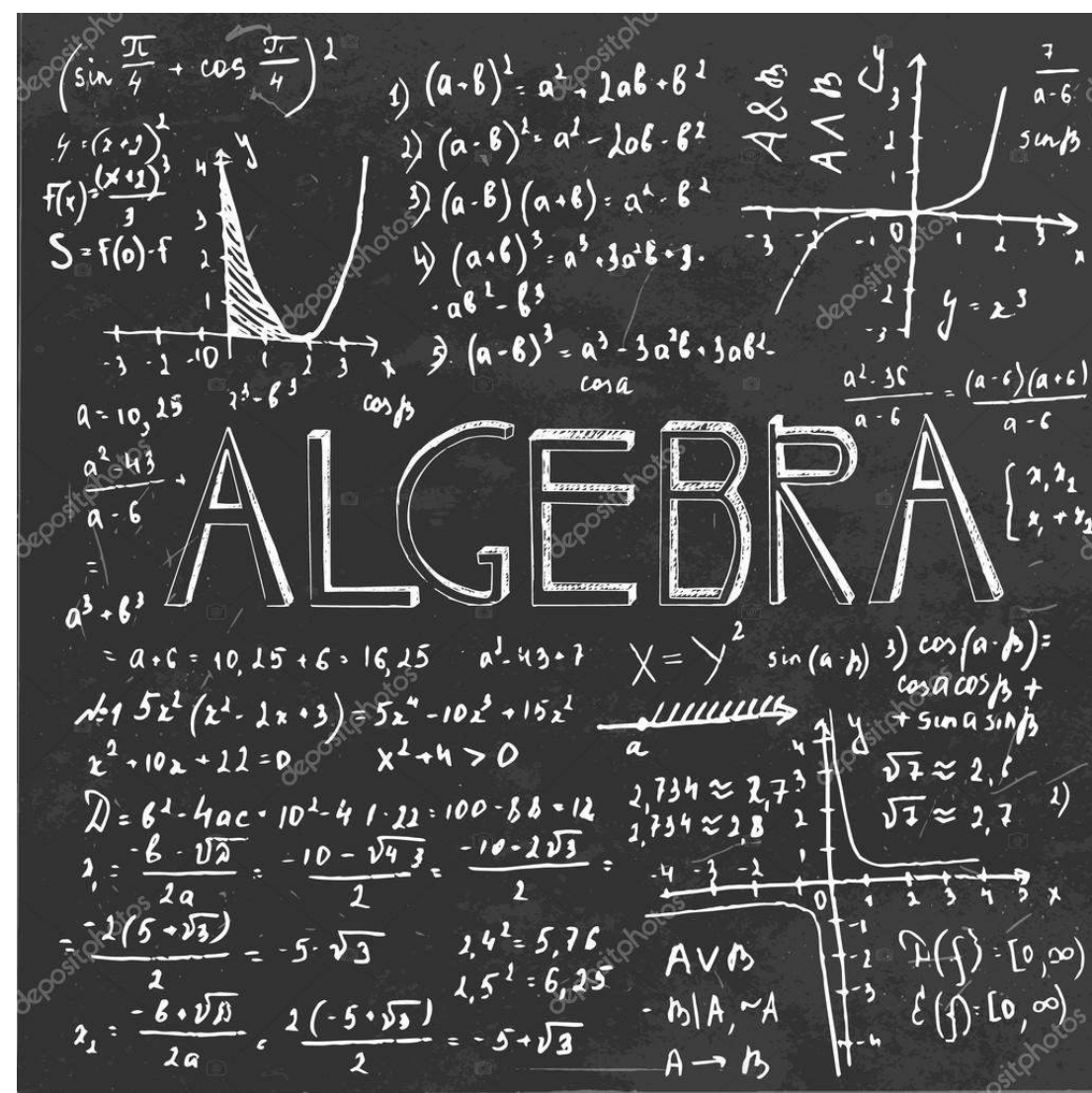
Is Math the Problem?

Statistics instructors frequently state that students do poorly because of mathematical deficiencies. This is a testable hypothesis previously examined:

Greer & Semrau (1984) with British psychology students
 Lalonde & Gardner (1993) with Canadian psych students
 Tariq (2002) with Northern Irish bioscience students
 Mulhern & Wylie (2004) revisiting British psych students
 Johnson & Kuennen (2006) with USA business students
 Harvey (2009) with British psychology students
 Galli, Chiesi, & Primi (2011) with Italian psychology students
 Lunsford & Poplin (2011) with USA general students
 Fonteyne et al. (2015) with Belgian first year students
 Carpenter & Kirk (2016) with USA psychology students
 Rabin et al. (2018) with USA general students
 plus others ...

Most studies, but not all, have found mathematics ability a usable predictor of statistics course performance.

Our goal was to create a short math diagnostic that assists with placement and support for weaker students, as our statistics student population is changing.



Requisite Changes

Previously, College Algebra or a qualifying math placement test score was required in order to enroll in Elementary Statistics. However, the Oklahoma statewide Regents adopted new Math Pathways in 2017. Statistics became a college gateway course that should have an option without prior college-level math. OSU Statistics decided to offer co-requisite support, but how would we determine which students should enter co-requisite?

Math placement test, often years old and not taken by transfer students?
 College-level math credit, which varies substantially between schools?
 Old ACT Math scores, not always available?
 High school grades, old, unreliable, and unavailable for transfer students?

We decided to develop a diagnostic quiz based on mathematics topics used in this non-simulation based elementary course. We looked at other tests, considered the topic list of Peck, Gould, & Utts (2017), and trialed a pilot diagnostic in Fall 2018.

IRB and OSU approvals were obtained; the quiz was built in Qualtrics. Calculators were not required.

Concepts of number: 7 questions
 Fractions, decimals, percentages: 6
 Algebra: 6

See Handout for Full Questions!

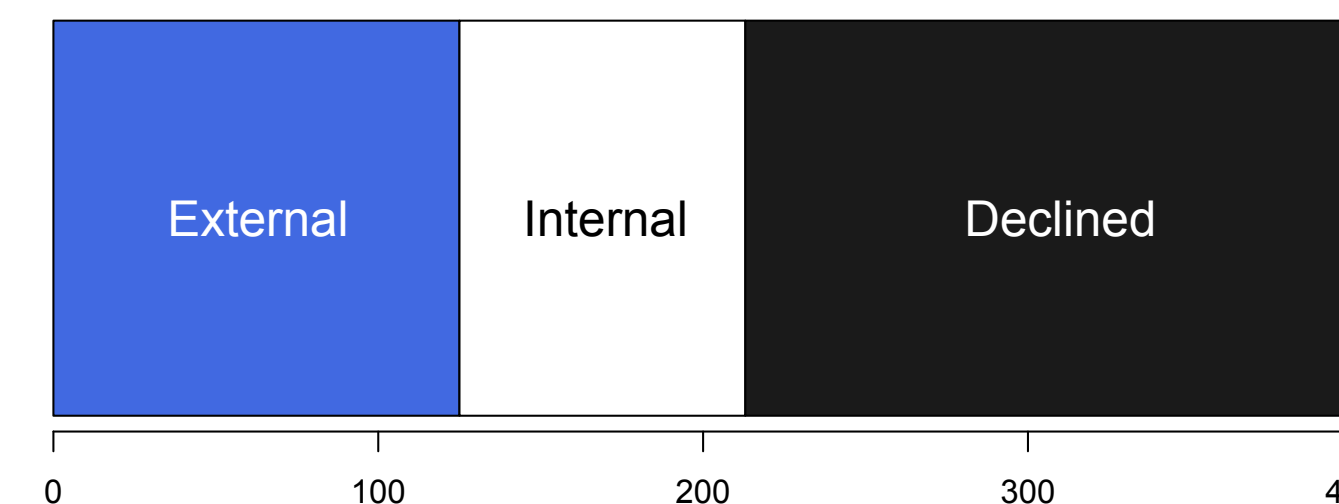
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Study Administration

During the first two weeks of Spring 2019, instructors from seven sections offered extra credit, about 0.5%, to students taking the quiz. Participants could choose external publication or internal for Oklahoma State only. Unfortunately, one section had mishandled consent forms; those quizzes were considered internal.

Immediately after taking the quiz, students saw questions they answered correctly and incorrectly. Unlike Lunsford, Poplin, & Pederson (2018), we did not mandate additional study time for low scorers, but we did offer resources and help sessions.

Response Rates



For sections with valid consent forms, overall response rate (external + internal) was 52%. Sections varied: 68%, 62%, 57%, 47%, 45%, 40%

Results presented here are from the 125 students allowing external publication. These students had higher mean course GPA than all 407 eligible participants, 3.06 external vs. 2.51 overall. Sample representativeness could be an issue.

Relationship to Grade

There was a "statistically significant" difference in math test score by course grade, with $F(3, 121) = 12.18$, $p\text{-value} < 0.001$.

Students with diagnostic scores of 11 or less earned C or lower grades over 50% of the time.

Results do not establish a causal relationship, nor suggest that math practice would help, but do support further investigation of mathematics placement and support.

Question Results

For $N = 125$ external publication students, Mean score 14.432 out of 19 (76%)
 $Q1 = 13$ Median = 15 $Q3 = 17$

Cronbach's $\alpha = 0.738$ (acceptable, not great)

#1 Square root of 0.04	57% incorrect
#19 Slope from two points	54%
#13 Percentage decrease	50%
#7 Order of operations	39%
#8 Fraction over fraction	30%
#11 Fraction to percentage	30%
#16 Algebra with exponent	29%
#5 Order of decimals	24%
#10 Fraction to rounded decimal	23%
#18 Solving for X with Y	21%
#12 Percentage to decimal	15%
#3 Scientific notation	14%
#6 Absolute value	14%
#15 Algebra with fractions	13%
#17 Solving for X	10%
#14 Algebraic substitution	10%
#4 Order of decimals	9%
#9 Two-thirds of 600	8%
#2 Rounding to two places	7%

