

4-2015

The Effects of An Early Intervention Mastery Activity in the Mathematics Department

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Wakefield, Nathan; Champion, Joe; Dailey, Doug; and Bolkema, Jessalyn, "The Effects of An Early Intervention Mastery Activity in the Mathematics Department" (2015). *DBER Speaker Series*. 78.

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Abstract for DBER Group Discussion on 2015-04-16

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Title:

The Effects of An Early Intervention Mastery Activity in the Mathematics Department

Abstract:

At the University of Nebraska-Lincoln, nearly 1000 students sign up for one of College Algebra, or College Algebra and Trigonometry every fall. Of these students, more than 75% are first time freshman. Finding ways to motivate and encourage these students together with early identification strategy for struggling students is critical to success not just in the math course, but also in a student's university career. This presentation will discuss the design and outcomes an early intervention mastery activity with the broad goals of helping students recall previously learned mathematics, and identifying students who are at risk for failure, all within two weeks of the start of the semester.

The Effects of An Early Intervention Mastery Activity in the Mathematics Department

Nathan Wakefield
Mathematics

Joint work with
Joe Champion, Boise State University
Doug Dailey, UNL
Jessalyn Bolkema, UNL

College Algebra

- Typically designed to prepare students for calculus.
- Not taken by all prospective calculus students but instead by those who have weaker high school mathematical backgrounds.
- Nationally DFW Rates commonly exceed 40% (Herriott and Dunbar, 2009).

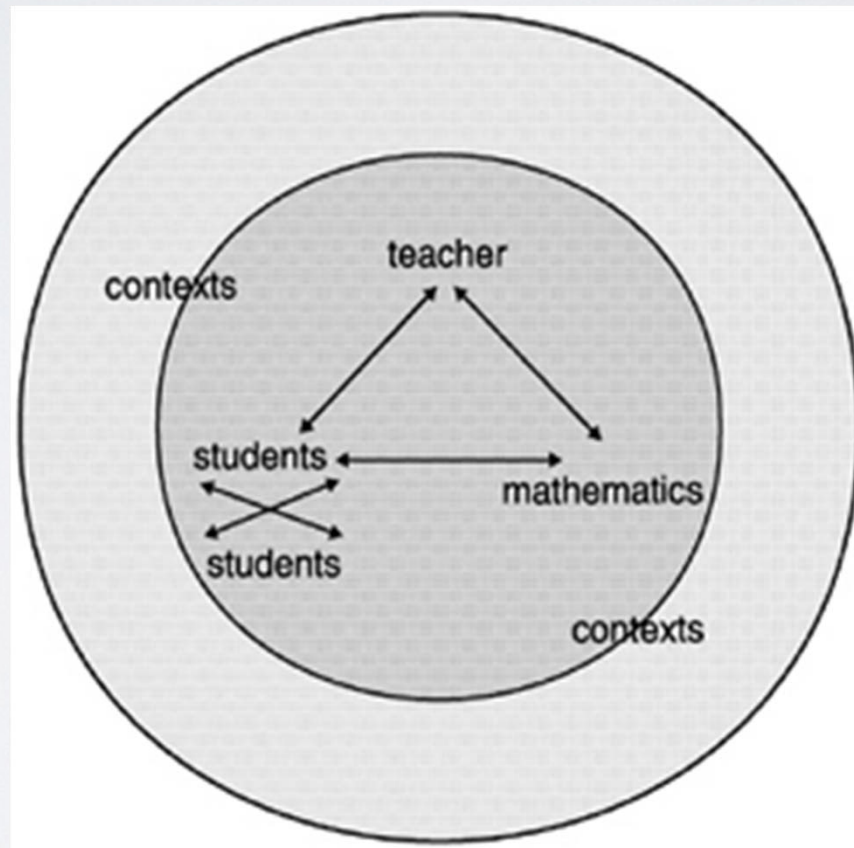
Solutions

- Better placement of students into the correct course.
 - ACT
 - ALEKS
 - In-House Exam

Framework

- Individual learners interact with material in a complicated way, bringing more than just domain specific skills to bear on a course.
- Bandura proposed a triadic reciprocity to help describe the interactions that take place when students learn (Bandura, 1986).
- These ideas have been adopted and refined by mathematics educators, (e.g. Cohen, Raudenbush, & Ball, 2002).

Triadic-Reciprocity



Limitations of High Stakes Placement

- High Stakes Exams may not accurately describe the student as a learner.
 - Self-Efficacy
 - Self-Concept
 - Motivation

Texas A&M University

- Early Intervention Program (Goonatilake and Chappa, 2010)
 - Target low-income minority students
 - Pre-Freshman Summer Camp
- Limitations: small population, high cost

What is at Stake?

- College Algebra as a gateway course
- In a society that is increasingly dependent on STEM, algebra may be the key prerequisite for economic opportunity (Dubinsky, 2013; Kamii, 1990;).

UNL Mathematics Strategy

- Mastery Activity:
 - Administered in written form on the first day of class.
 - Students have the opportunity to continue taking the exam once per day for two weeks.

The Format

- 12 Questions chosen from 12 topics.
- Topics and skills deemed to be prerequisite knowledge for college algebra students at UNL
- A passing score is an 80%. Student either pass or fail the exam.
- The exam is worth roughly 5% of the final grade.

Topics on the Exam

PME Question	NE State Standard	Common Core	“Functions Modeling Change”
1	MA 12.3.3.j	6.EE.1	Chapter 11 Skills Refresher
2	MA 12.1 .3.b	8.EE.1	Chapter 4 Skills Refresher
3	MA 12.3.3.b	8.EE.1	Chapter 4 Skills Refresher
4	MA 12.3.3.b	8.EE.1	Chapter 4 Skills Refresher
5	MA 5.1.3.a	5.NF.1	Chapter 11 Skills Refresher
6	MA 12.3.3.e, MA 12.3.3.j	A-APR.6	Chapter 4 Skills Refresher
7	MA 7.3.3.b, 7.3.3d, 8.3.3.c	8.EE.7	Chapter 1 Skills Refresher
8	MA 7.3.3, 8.3.3d	6.EE.5-8	N/A
9	MA 12.3.3o	F-BF.1	2.4
10	MA 12.3.1	F-LE.2	1.4
11	MA 12.3.1c	F-LE.2	1.4
12	MA 12.3.3p	8.EE.8	Chapter 1 Skills Refresher

Research Questions

1. To what extent can performance on an early-semester mastery activity be used to identify students at increased risk of failing College Algebra?
2. To what extent is success on an early-semester mastery activity predictive of students' performance on subsequent College Algebra assessments?

The Population

- 959 students enrolled in college algebra and precalculus courses at UNL.
- The average math and composite ACT scores for college algebra students were 21.75 and 22.84, respectively.
- For precalculus students, the average math and composite ACT scores were 23.59 and 24.08, respectively.

The Population

- 462 females and 497 males
- First-time freshman comprised 80.4 %, and other freshman and sophomores 13%
- Self-reported majors:
 - STEM/pre-health 34.7%
 - Business 21.2%
 - Undeclared students 17.2%

The Course Sections

- 16 Sections of College Algebra
- 10 Sections of College Algebra and Trigonometry (Pre-Calculus)
- The Instructors of Record:
 - Graduate Teaching Assistants-20 Sections
 - Lecturers-5 Sections
 - Faculty-1 Section

Course Coordination

- Close Coordination:
 - Common lesson plans
 - Common in-class worksheets
 - Common quizzes
 - Common online homework
 - Common exams
- Two graduate students (associate conveners) assisted one faculty member to administer the two courses.
- Though instructors did grade their class's own team quizzes (12% of the total course grade), exams were commonly graded to prevent large discrepancies in grading between sections.

Data Collection

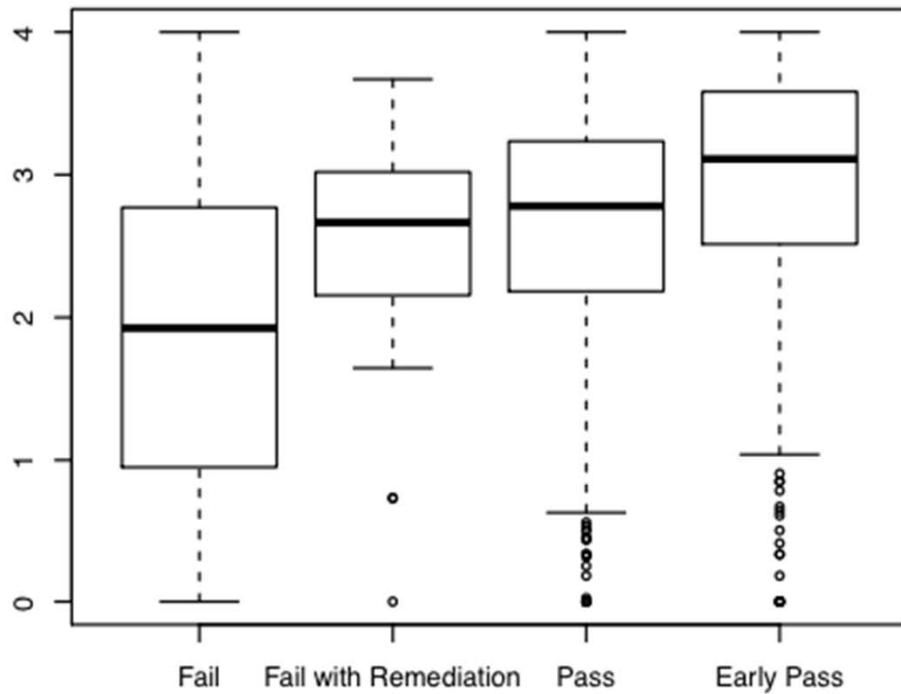
- Data was collected for the Fall 2014 semester.
- Each instructor submitted their final grade-book at the end of the semester.

Analysis

- Independent Variables:
 - ACT-Math
 - High School Percentile
 - PME Status (Passed within first three days, passed, failed but close and willing to remediate, failed.)
- Dependent Variable: Course Pass/Fail

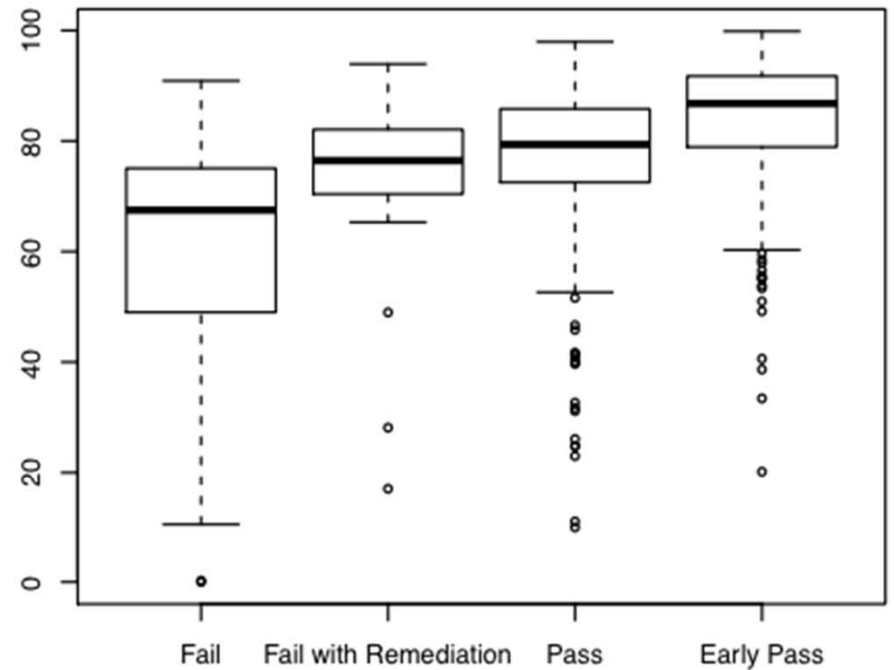
Some Indicators

trm_gpa_nonmath by PME_Level
N= 907



category subcounts: 94,32,395,386

CoursePercent_noPME by PME_Level
N= 910



category subcounts: 88,34,395,393

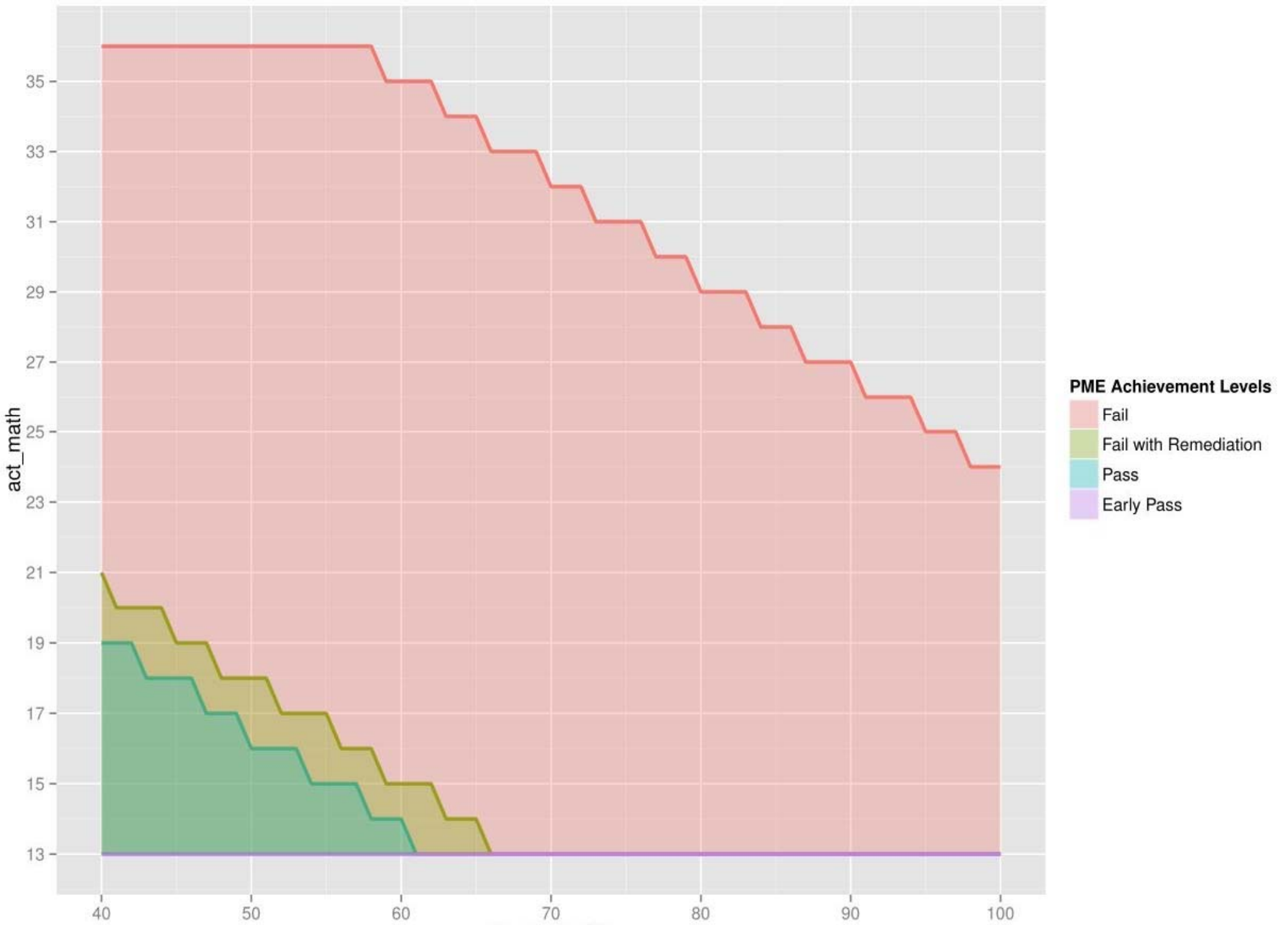
Logistic Regression

Pass:Fail

	Estimate	Std. Error	z value	Pr(> z)
• (Intercept)	-2.802671	0.659991	-4.247	2.17e-05
• act_math	0.081398	0.029586	2.751	0.00594
• hs_percentile	0.022897	0.004833	4.738	2.16e-06
• CourseNamePre-Calc	-1.054000	0.216032	-4.879	1.07e-06
• PME_LevelFail with Remediation	1.625450	0.521986	3.114	0.00185
• PME_LevelPass	1.742987	0.274339	6.353	2.11e-10
• PME_LevelEarly Pass	2.330650	0.315749	7.381	1.57e-13

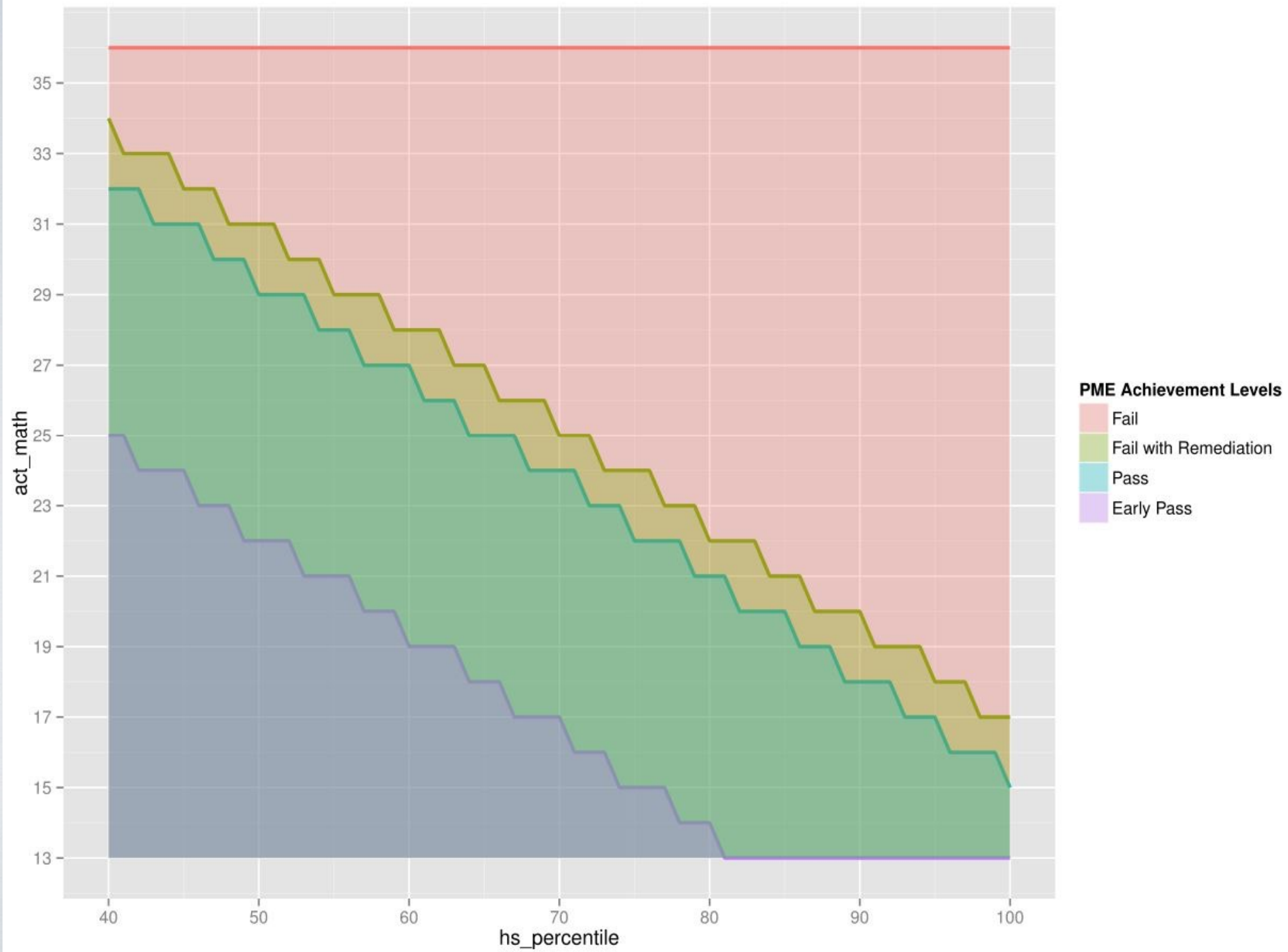
At Risk to Fail College Algebra

Shaded Regions = Computed Risk of Failure Exceeds 20%



At Risk to Fail Precalculus

Shaded Regions = Computed Risk of Failure Exceeds 20%



Conclusions

- We have a means of identifying “at-risk” students early in the semester.
- We can focus intervention efforts on students who are likely to underperform.

Next Steps

- Develop a meaningful intervention for at-risk students.
- Test intervention measures.

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