Getting Past the Gatekeeper: Does Randomization-Based Curriculum in Introductory Statistics Promote Student Success?

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Introduction

- Stat 216 (Introduction to Statistics) is the largest course taught at Montana State University (MSU)
- Multiple sections (16 to 22) taught each semester with around 40 students per section
- Taught primarily by graduate students and non-tenure track faculty
- Often viewed as a "gatekeeper" course–required by most degree programs at MSU

- From Fall 2013 through Fall 2015 four different curricula were used:
    - Traditional (DVB): based on DeVeaux, Velleman and Bock's *Intro Stats*
    - CATALST: used materials developed for a terminal introductory statistics course by CATALST
    - Lock^5: based on the Lock et al's *Unlocking the Power of Data*
    - MSU: set of materials developed by Jim Robison-Cox that combines elements of several randomization- and simulation-based curricula (e.g. Lock^5, Tintle et al, CATALST)
- Overarching question: do success rates (students receiving a grade of C or higher) differ among the curricula?

Data

- Obtained data collected by the Office of the Registrar
- 3857 students took Stat 216 from Fall 2013 through Fall 2015
- Included undergraduate students taking the course for the first time ($n = 2925$)
- Response: Success (earned grade of C or higher) or Non-success (earned D or F or withdrew from the course)

- Classroom characteristics
  - Curriculum used
  - Type of room course was taught in (Technology Enhanced Active Learning (TEAL) classroom or traditional classroom)
  - Year (indicator variables)
  - Term (fall or spring)
  - Time of day (afternoon or morning)
- Due to confounding issues we cannot include if the class was taught on MWF or TTh

- Student characteristics
  - Previous semester's cumulative GPA
  - Standardized test prerequisite checks (dummy variables for three tests (ACT, SAT, and Math Placement Exam (MPLEX) where 1=took the exam and earned a score to satisfy the prerequisite for the course and 0=took the exam and did not earn a score to satisfy the prerequisite OR did not take the exam)
  - Math history prerequisite checks (dummy variables for nine lower level math courses where 1=took the course and earned a C or higher and 0=took the course and earned a C- or lower OR did not take the course)

Methods

- Summary statistics: success rates by curriculum
- Logistic mixed model:
  - Response: Success or non-success
  - Fixed effects: student and classroom characteristics
  - Random effect: instructor

Results: Summary Statistics

	Non-success		Success	
Curriculum	n	%	n	%
CATALST	94	13.53	601	86.47
DVB	151	27.66	395	72.34
Lock	188	34.64	575	75.36
MSU	159	17.26	762	82.74
Total	592	20.24	2333	79.76

Results: Logistic Mixed Model

- Differences in success rates among curricula (F=3.34, p-value=0.0185 on 3 and 2858 df)

- Tukey-Kramer adjusted pairwise CIs for the odds ratios:

Curricula	Odds Ratio	CI (Odds Ratio)
CAT vs DVB	1.607	(0.600, 4.307)
CAT vs Lock	2.721	(1.156, 6.406)
CAT vs MSU	1.830	(0.629, 5.320)
DVB vs Lock	1.693	(0.722, 3.967)
DVB vs MSU	1.138	(0.292, 4.434)
Lock vs MSU	0.673	(0.283, 1.597)

Conclusions

- After accounting for student and classroom characteristics and instructor effect, minimal difference among sucess rates
- Other salient characteristics that may be important were not included (e.g. student motivation and instructor ability) as the data are not available or are hard to quantify
- Randomization- and activity-based curricula have other benefits not measured in this study such as increased class attendance and greater student accountability