Success of CSULB Students in Introductory Mathematics and Statistics Courses

Jen-Mei Chang, Dana Hooten, Tangan Gao, Kris Slowinski, Tianni Zhou
College of Natural Sciences and Mathematics

1. Why introductory mathematics/statistics?

2. Data analysis of Early Start Mathematics Program and GE B2 QR/Mathematics courses led to improved placement and targeted student support in redesign project

3. Conclusions and recommendations

CSULB NON-COMPLETION OF COURSES

AY 16-17:

    2,462 COURSES
    284,090 ENROLLED STUDENTS
    19,403 D, F, WU GRADES (6.8%)

CSULB TOP 100 "NON-PASSING" COURSES

AY 16-17:

    100 COURSES
    86,882 ENROLLED STUDENTS
    9,875 D, F, WU GRADES (11.4%)

IN THIS GROUP

AY 16-17:

    13 COURSES IN MATH
    8,001 ENROLLED STUDENTS
    1,763 D, F, WU GRADES (22.0%)

	TOTAL # OF GRADES	UNIV SHARE	D+F+WU GRADES	D+W+WU UNIV SHARE	NON COMPLETION RATE
CSULB	284090	100.00%	19403	100.00%	6.83%
CLA	97633	34.37%	7573	39.03%	7.76%
CHHS	52057	18.32%	1972	10.16%	3.79%
CNSM	33780	11.89%	4501	23.20%	13.32%
COTA	32143	11.31%	1179	6.08%	3.67%
COE	28244	9.94%	1735	8.94%	6.14%
CBA	27092	9.54%	2109	10.87%	7.78%
CED	10012	3.52%	255	1.31%	2.55%
UNIV	3129	1.10%	79	0.41%	2.52%
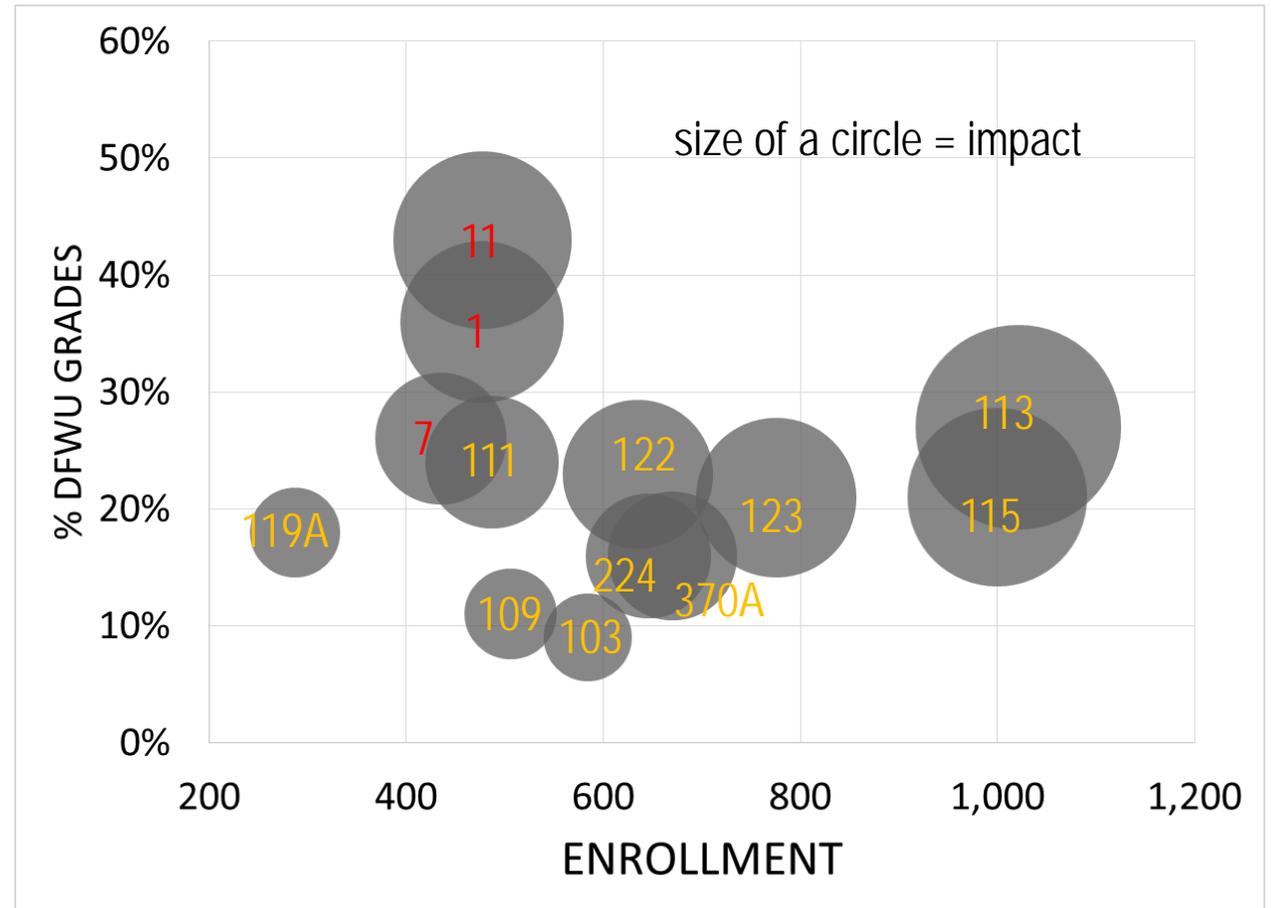
SOURCE: CSU CO DASHBOARD

size of a circle = impact

Current Mathematics Pathways

MAPB 1

MAPB 7   MAPB 11

GE MATH   MATH 115   MATH 113   MATH 111

STAT 108
MATH 103

MATH 122

MATH 123

Current Mathematics Pathways

MAPB 1

MAPB 7   MAPB 11

GE MATH
STAT 108
MATH 103

MATH 115   MATH 113   MATH 111

MATH 122

MATH 123
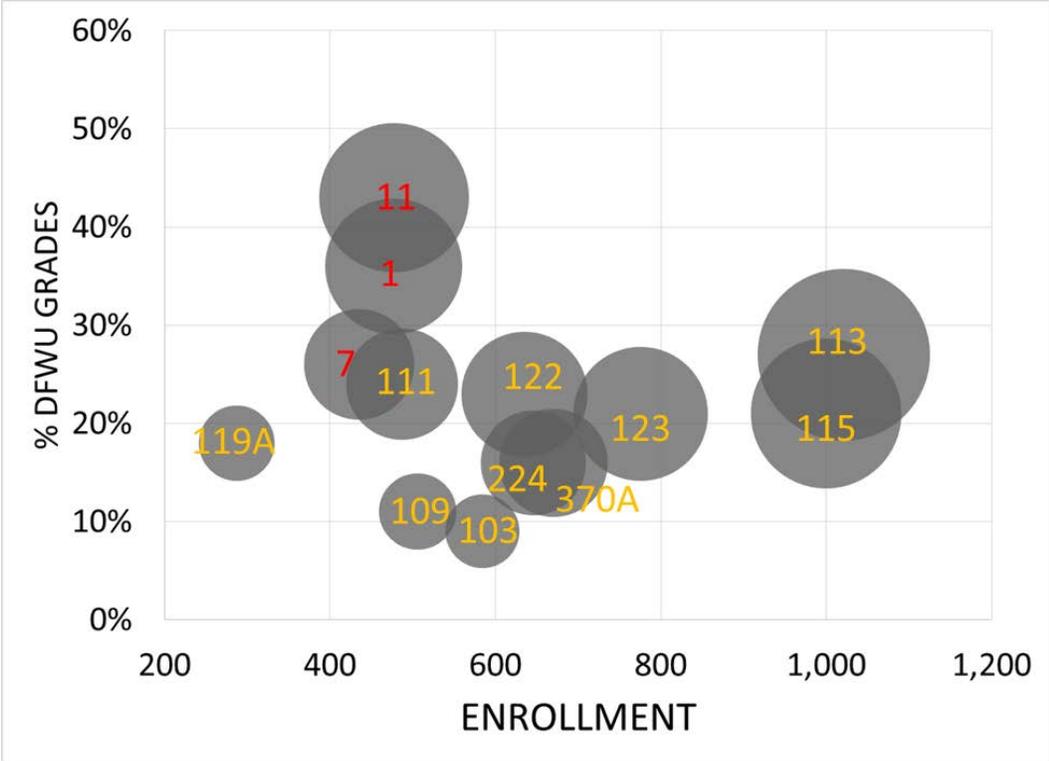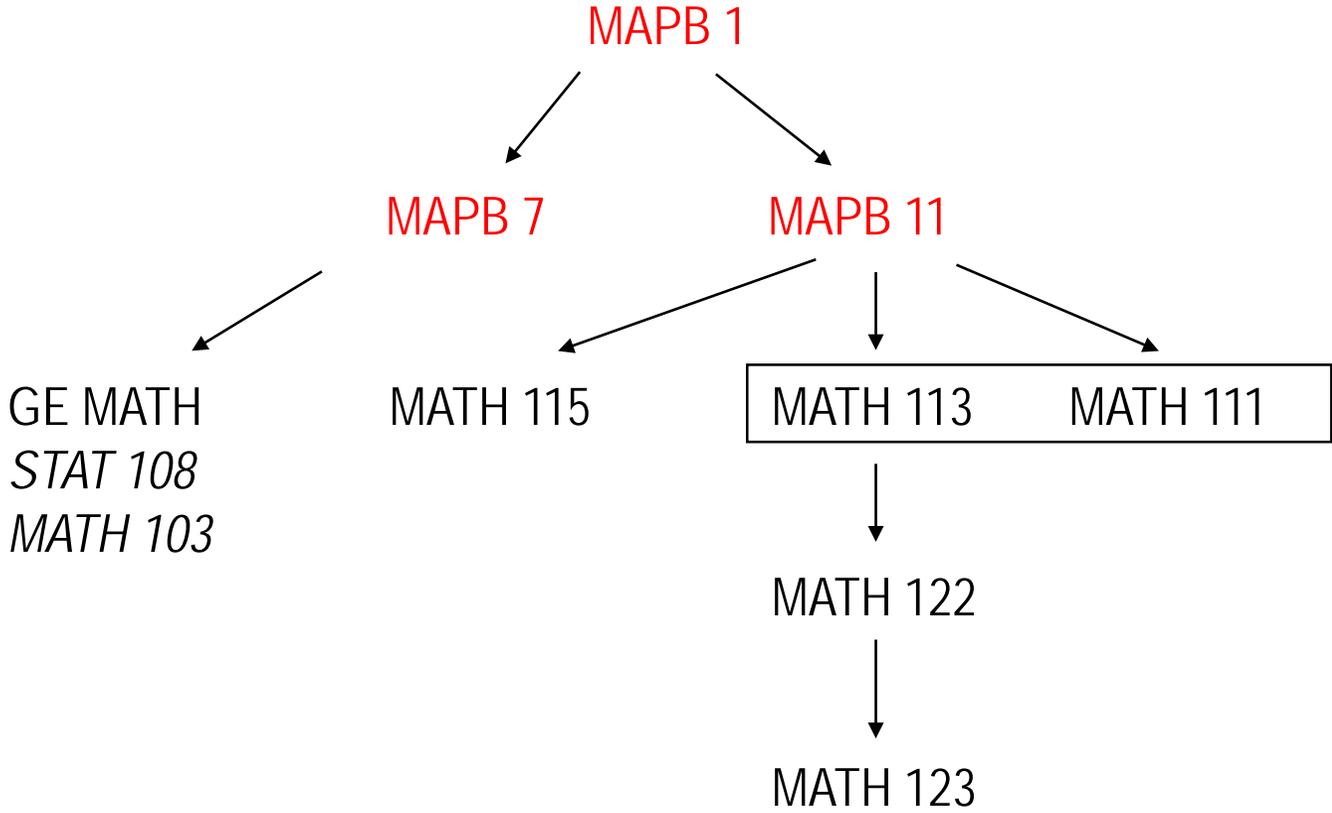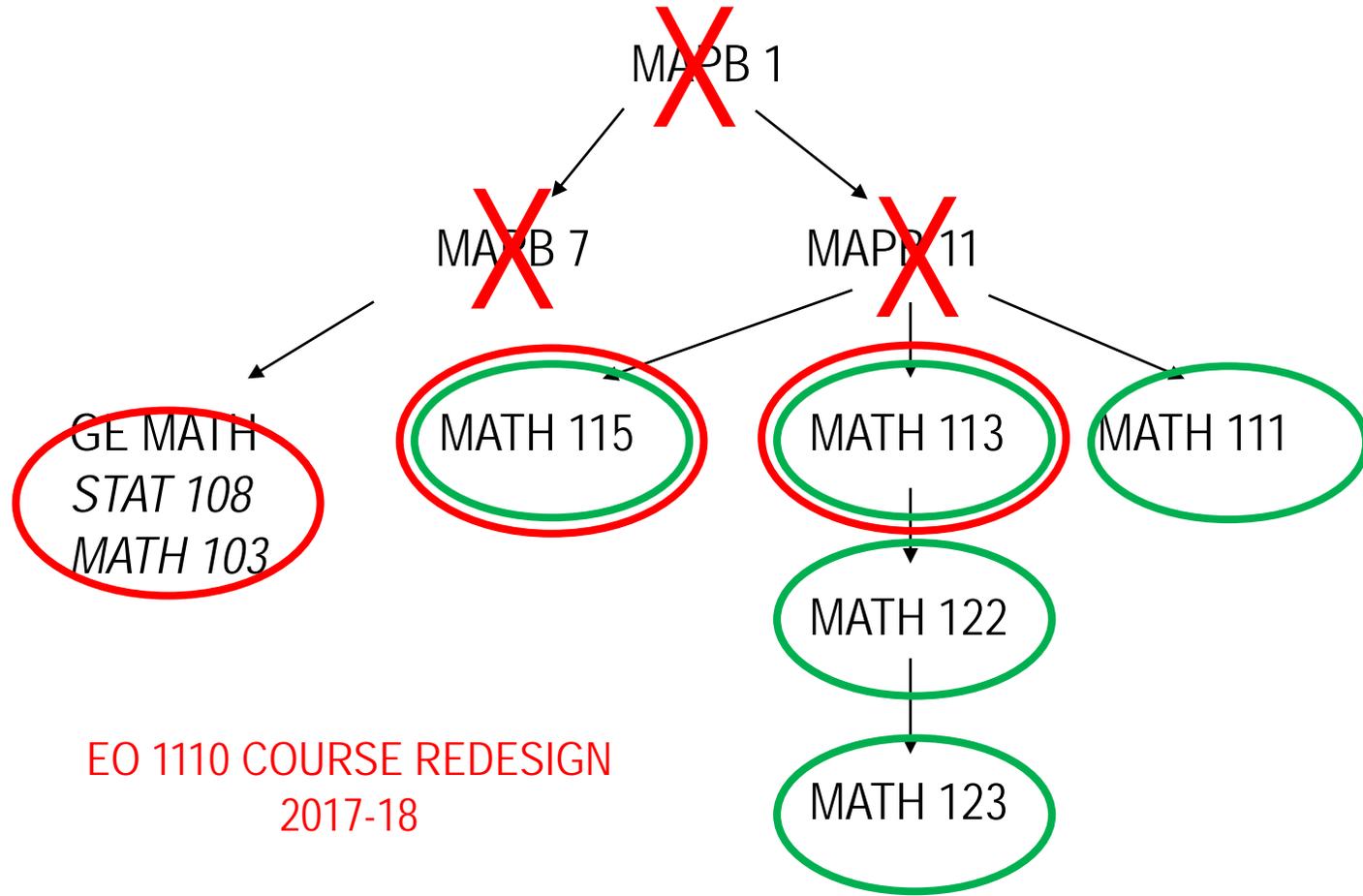
EO 1110 COURSE REDESIGN
2017-18

COURSE REDESIGN 2012-16
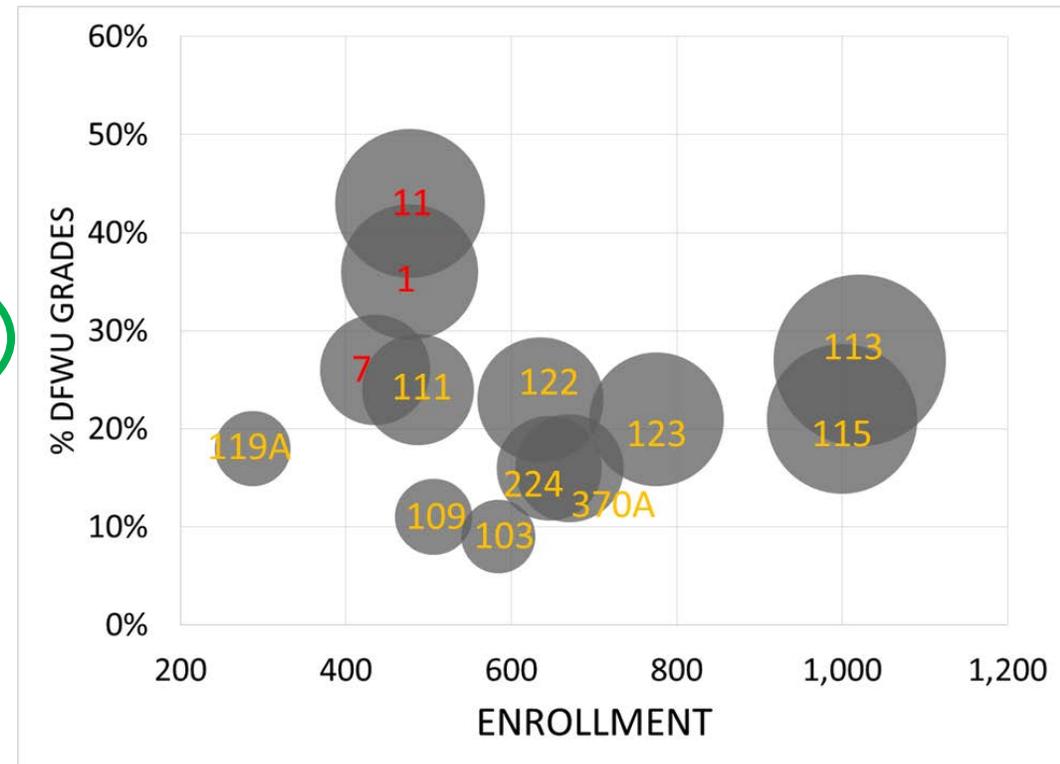
SUMMARY AND RECOMMENDATIONS
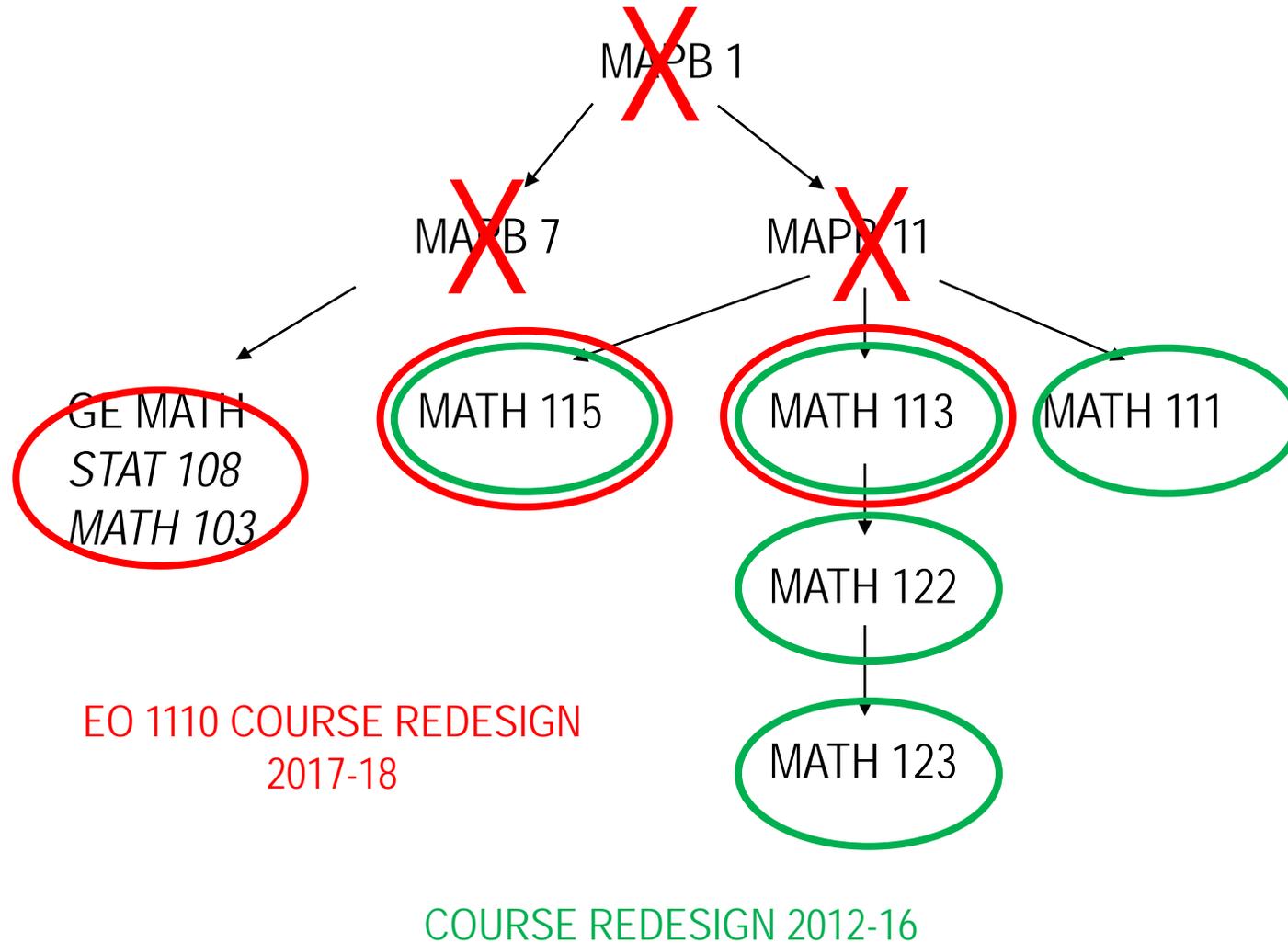
EO 1110 COURSE REDESIGN 2017-18

COURSE REDESIGN 2012-16

- EARLY START COMBINED WITH ADAPTIVE LEARNING IS VERY EFFECTIVE IN IMPROVING STUDENTS' PREPARATION AND PLACEMENT

- HS GPA AND SAT CORRELATE WITH FRESHMAN SUCCESS IN ALGEBRA

Student success builds upon students' success in their first (and introductory) Mathematics/Statistics courses!
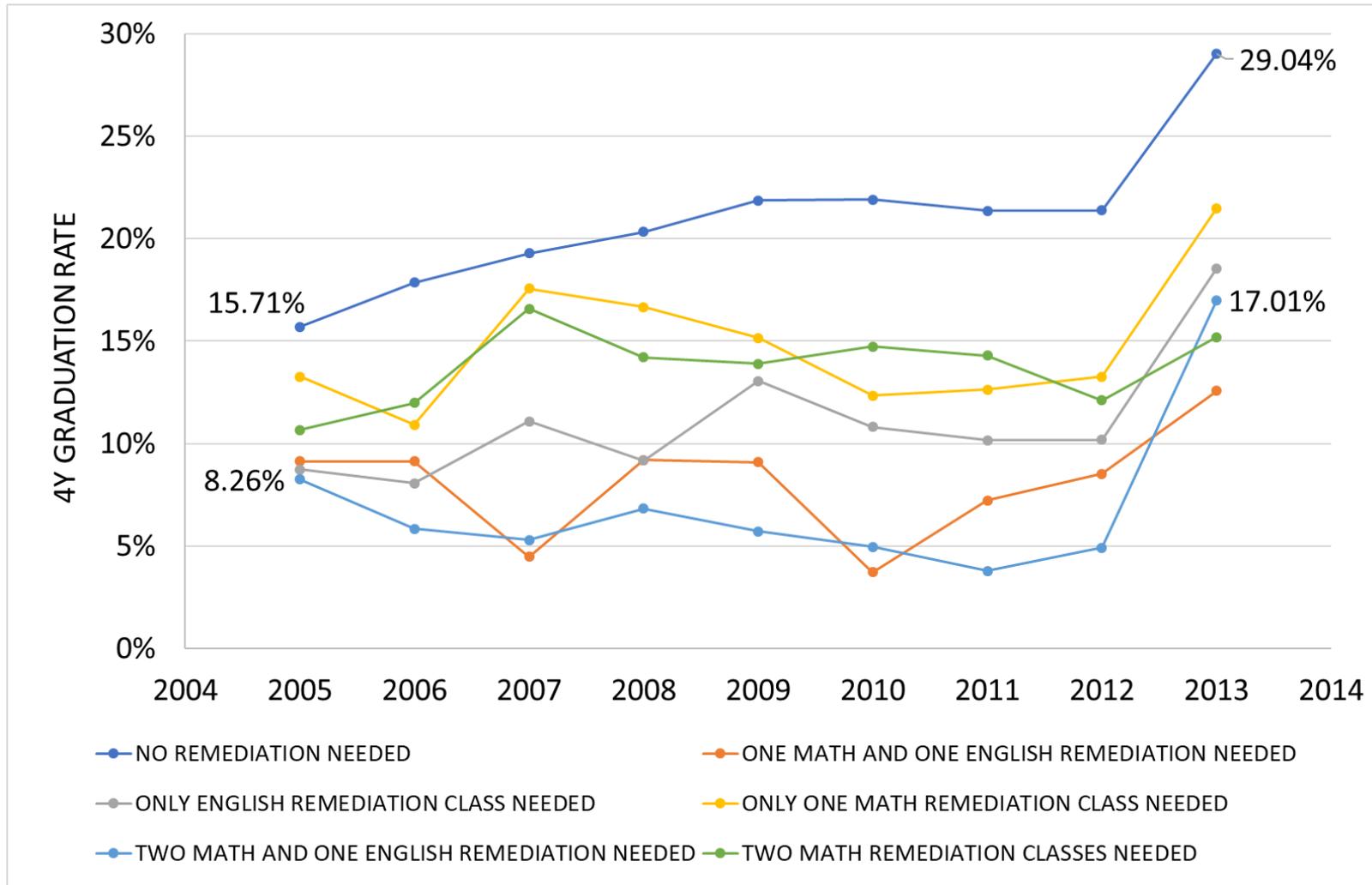
Data analysis of Early Start Mathematics Program and GE B2 QR/Mathematics courses led to **improved placement** and **targeted student support in redesign project**
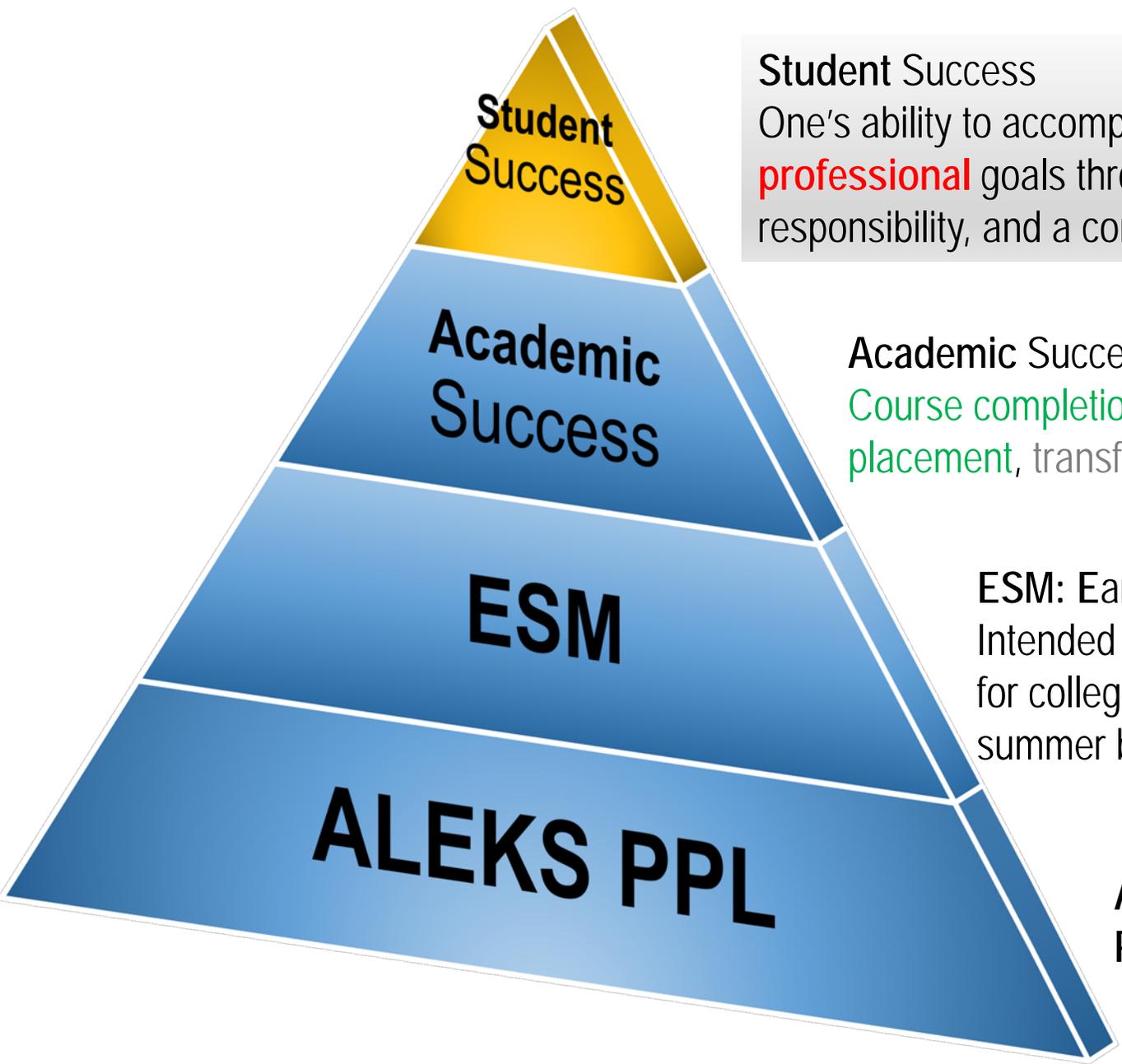
Student Success
One's ability to accomplish their current and future academic, personal, and professional goals through the development of knowledge, a sense of responsibility, and a connection to the university and wider community.

Academic Success
Course completion, subsequent course completion, accurate course placement, transferring of content knowledge, on-time graduation.

ESM: Early Start Mathematics
Intended for incoming students who do not demonstrate readiness for college-level math to begin developmental work during the summer before coming to the CSU.

ALEKS: Assessment and LEarning in Knowledge Spaces
PPL: Placement, Preparation and Learning

2017 Early Start Mathematics Program at CSULB

3-unit

(ESM 3, 21, 33)

1-unit

(ESM 1, 11)
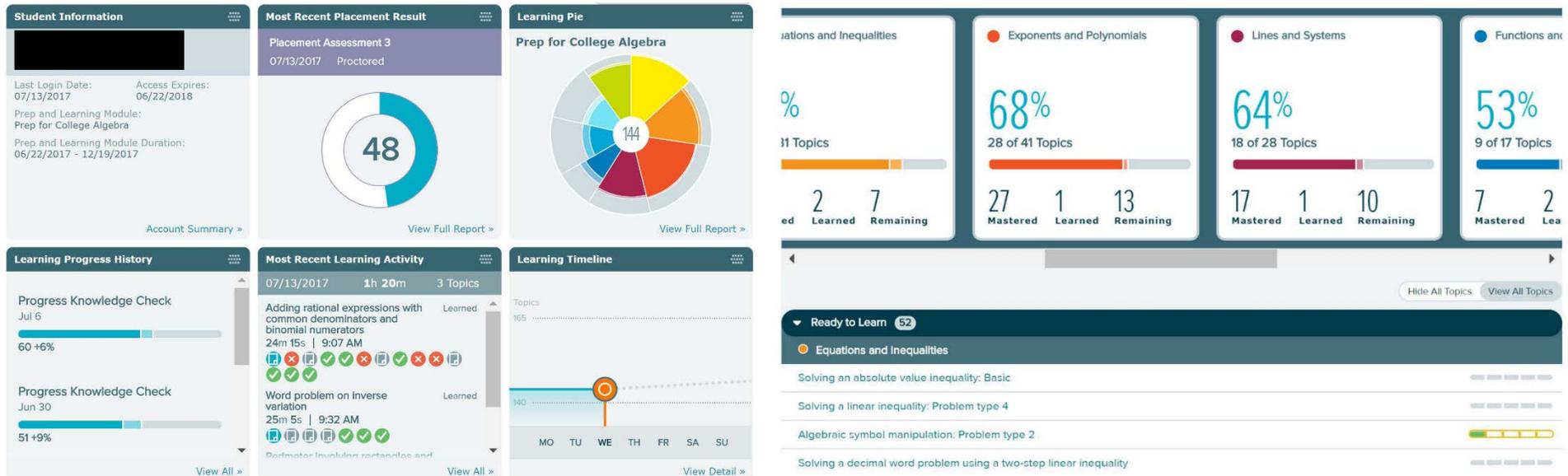
Successful program completion

$y = 0.015x - 29.27$
$R^2 = 0.9375$
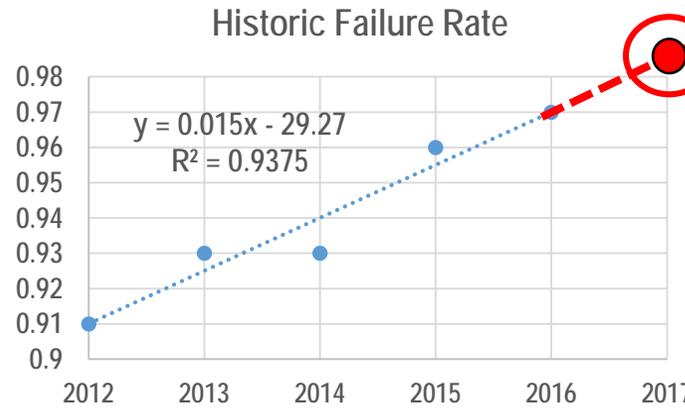
On target to "lose" 98.5% or **318** students in 2017 while, in fact, **115** were lost. **The new format w/PPL saved 203 students at least one semester of dev math** at CSULB.

2012	2013	2014	2015	2016	2017

Introduction of PPL & 4- week format

731

267

298

394

438

323

668

247

277

378

426

115

LONG BEACH STATE UNIVERSITY

A California State University Campus
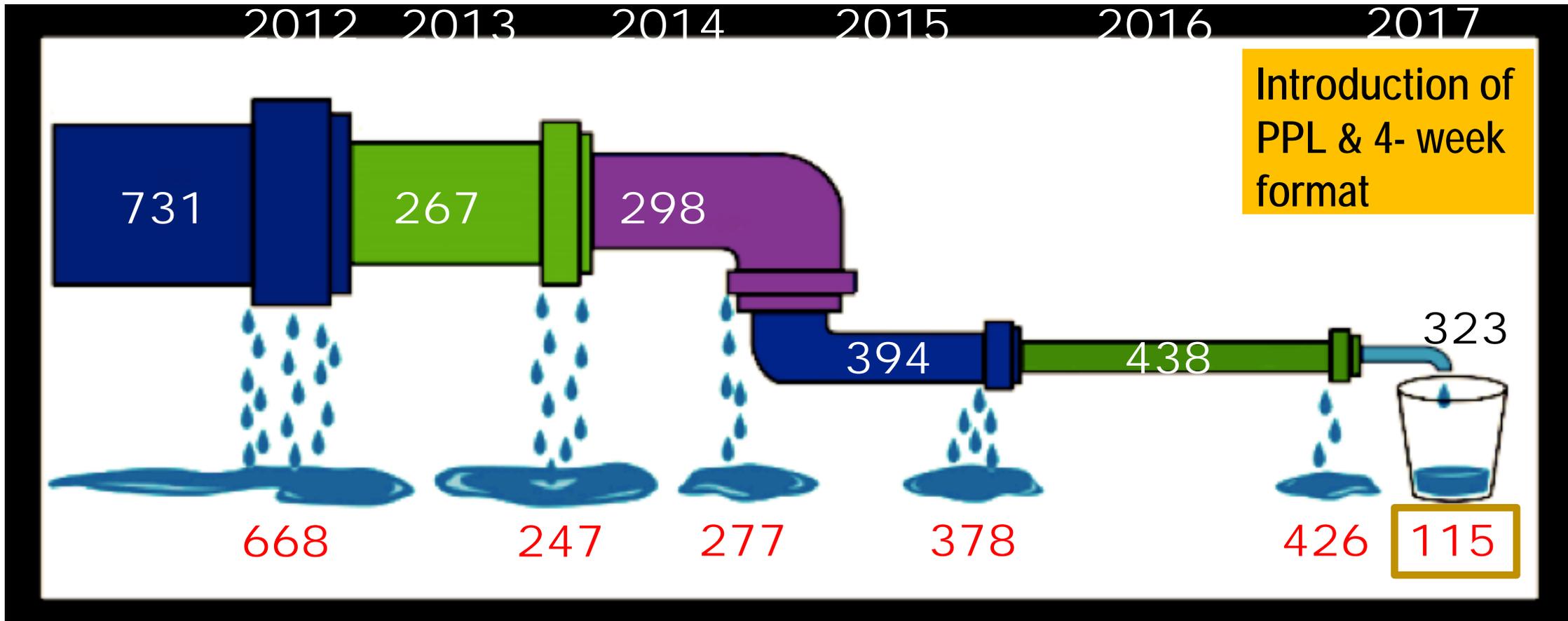
1-unit ESM with ALEKS PPL in 2017

Course Outcomes

CR: advance to the next level

- **30** - **45:** dev math level 1 → dev math level 2

- **46 or higher:** dev math level 2 → GE math

RP: satisfied the CSU ESM requirement, but do not advance to the next level

NC: did not complete CSU ESM requirement, fall admission is jeopardized

		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Week 1		7/10	7/11	7/12	7/13	7/14	7/15	7/16
		Take the initial proctored assessment	Work in ALEKS for a minimum of 5 hours between class meetings.					
		Visit the tutoring center for additional support						
Week 2		7/17	7/18	7/19	7/20	7/21	7/22	7/23
		Continue working in ALEKS; take unproctored assessment for practice	Work in ALEKS for a minimum of 5 hours between class meetings.					
		Visit the tutoring center for additional support						
Week 3		7/24	7/25	7/26	7/27	7/28	7/29	7/30
		Continue working in ALEKS; take unproctored assessment for practice	Work in ALEKS for a minimum of 5 hours between class meetings.					
		Visit the tutoring center for additional support						
Week 4		7/31	8/1	8/2	8/3	8/4	8/5	8/6
		Take the final proctored assessment						
		Visit the tutoring center for additional support						

Successful ESM completion & subsequent course completion lead to improved placement in the 1st GE B2 course at CSULB

109
CR in dev math level 1

78
Enrolled in dev math level 2

41
Passed
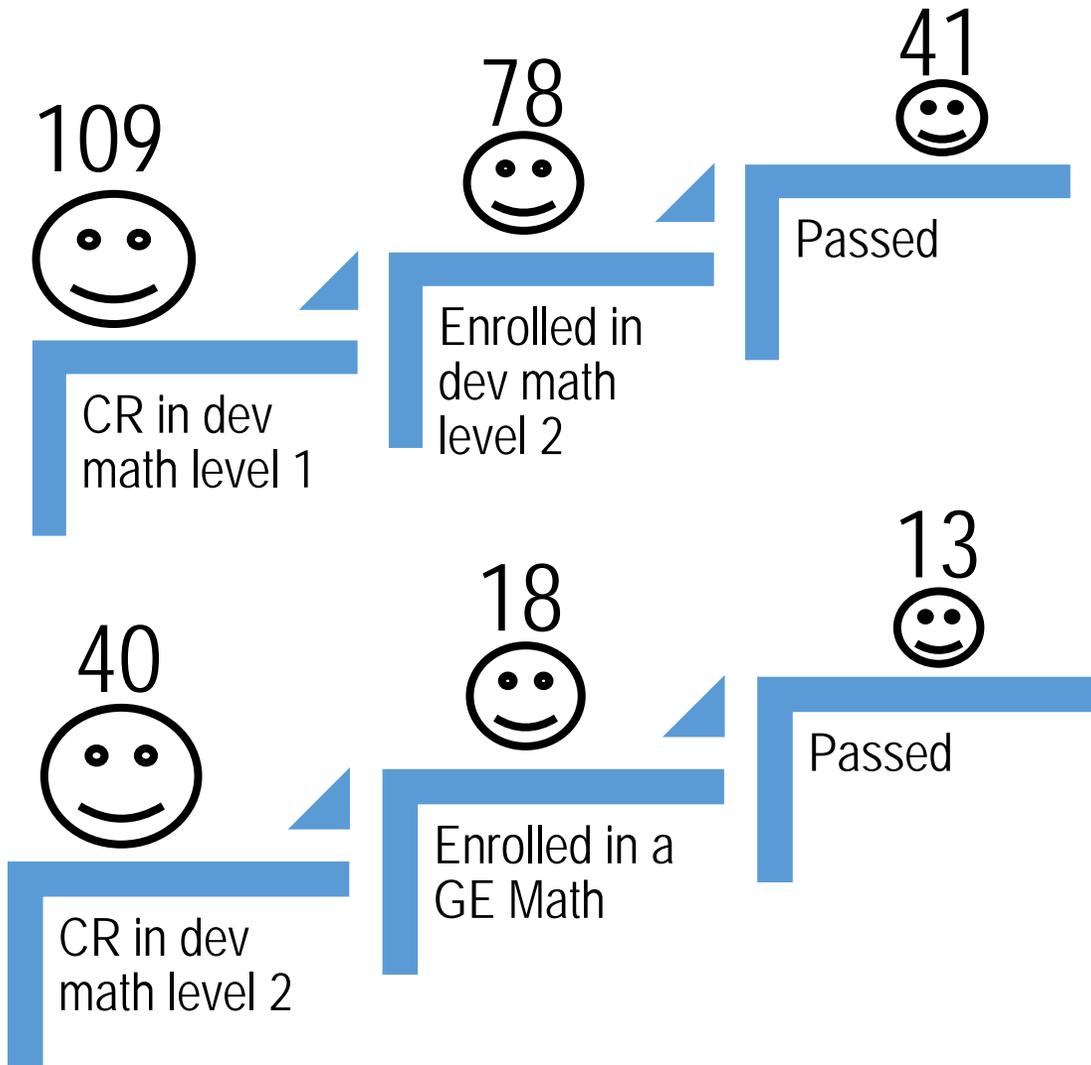
52.6% Completion rate with PPL
vs.
70% Completion rate without PPL

→ **Inaccurate placement** with PPL cut score of **30** for dev math level 2

BUT, dev math courses are GONE under EO 1110

40
CR in dev math level 2

18
Enrolled in a GE Math

13
Passed

72.2% Completion rate with PPL
vs.
75.11% Completion rate without PPL

→ **Accurate placement** with PPL cut score of **46** for entry-level GE Math/QR courses

Targeted student support in GE B2 redesign

Graphics Key:

Bottleneck course

Eliminated under EO 1110

Created under EO 1110

Undergoing course redesign under EO 1110

Dev math level 1

Dev math level 2 for non-STEM

Dev math level 2 for STEM

Intro to Stats

Quantitative Reasoning

Pre-Calculus Algebra

Business Calculus, Liberal Studies Math, Calculus

Co-requisite for Intro to Stats

Co-requisite for QR

Co-requisite for Pre-Calculus Algebra

Co-requisite for Business Calculus, Liberal Studies Math

LONG BEACH STATE UNIVERSITY

A California State University Campus

Placement of GE B2 courses with ALEKS PPL
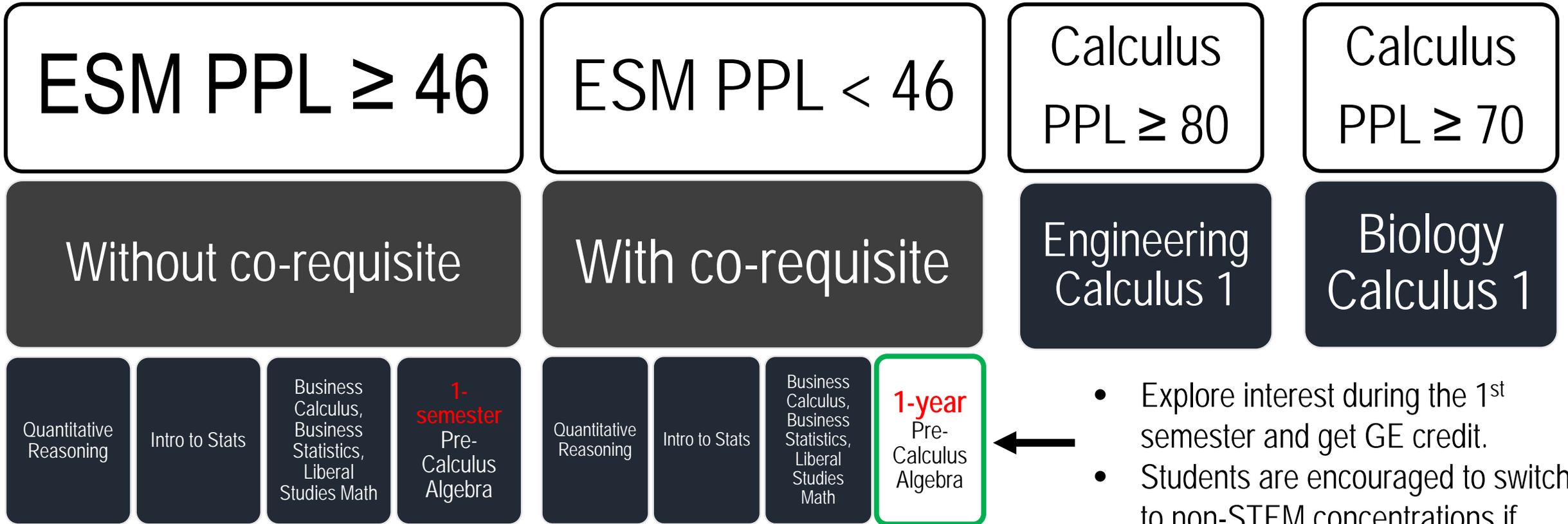
| ESM PPL ≥ 46	ESM PPL < 46	Calculus PPL ≥ 80	Calculus PPL ≥ 70
Without co-requisite	**With co-requisite**	**Engineering Calculus 1**	**Biology Calculus 1**
Quantitative Reasoning • Intro to Stats • Business Calculus, Business Statistics, Liberal Studies Math • **1-semester** Pre-Calculus Algebra	Quantitative Reasoning • Intro to Stats • Business Calculus, Business Statistics, Liberal Studies Math • **1-year** Pre-Calculus Algebra		

- Explore interest during the 1st semester and get GE credit.
- Students are encouraged to switch to non-STEM concentrations if receiving C or lower.

Placement of GE B2 courses
(mostly Algebra)
with
high school GPA and Math SAT

Success in Algebra depends on HS GPA and Math SAT

Math 113 Pre-Calculus Algebra Fall 2016

Math SAT

Fail

Pass
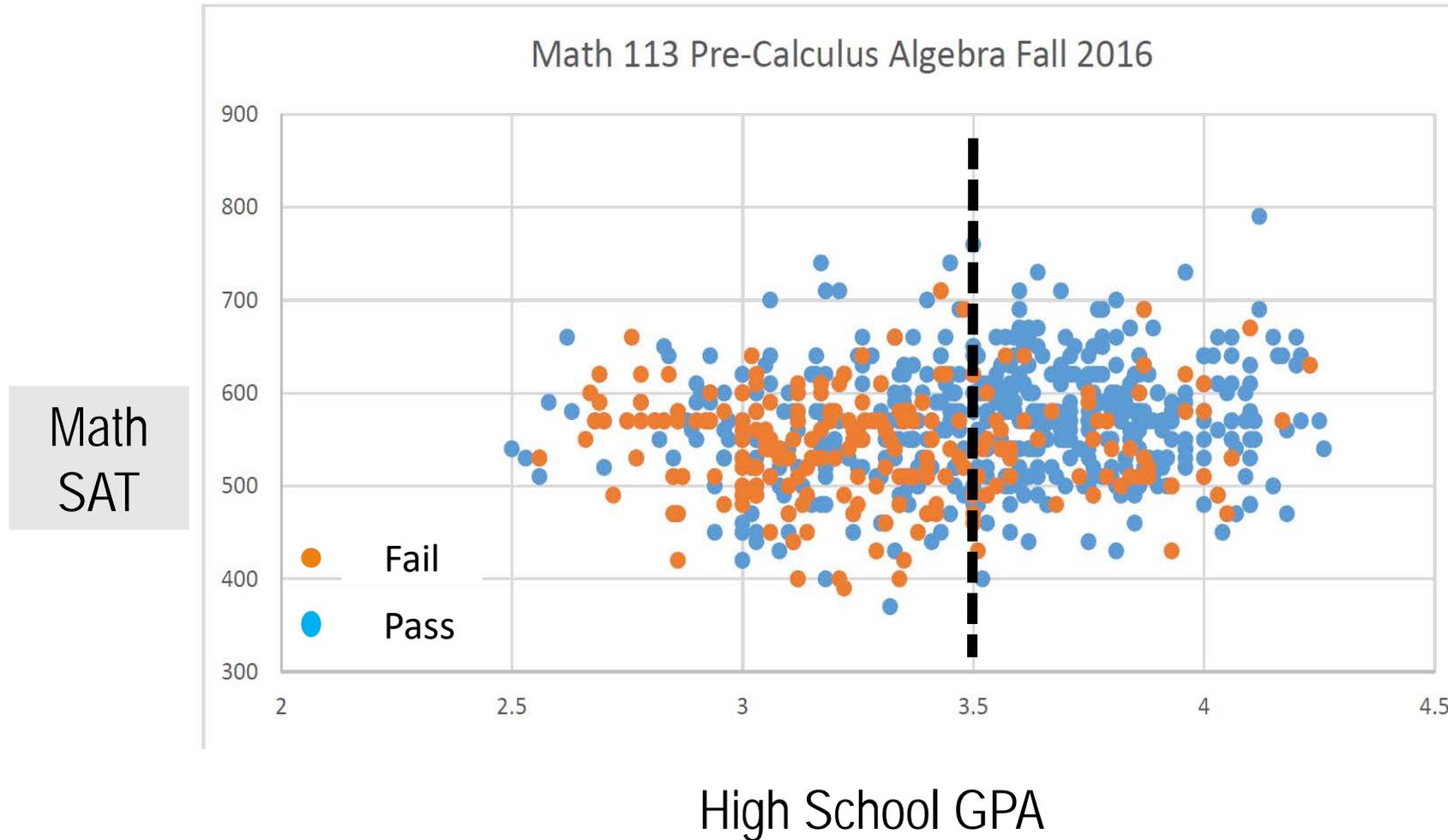
High School GPA

591 students:

421(71%) passed

170 (29%) failed

Predictive Model with Logistic Regression

- Estimate the probability of a student pass Math 113 based on his/her high school GPA and math SAT scores

- The estimated logistic regression model based on Fall 2016 data is

    logit $(\widehat{p_i})$ = -10.544 + 2.08 * GPA_i + 0.0077 * SAT_i

OR

$$\widehat{p_i} = \frac{e^{(-10.544 + 2.08 * GPA_i + 0.0077 * SAT_i)}}{1+e^{(-10.544 + 2.08 * GPA_i + 0.0077 * SAT_i)}}$$

- Built the model based on Fall 2016 data

- Applied the model to the Fall 2017 data

- Made prediction of each student who took the class in Fall 2017

Case Summaries

	High School GPA	Math SAT	Pass Math 113 in Fall 2017 (actual Outcome)	Predicted Probability of pass Math 113 in Fall 2017	Predicted Outcome	
1	3.30	560	Fail	0.656	Pass	Dangerously Misclassified
2	3.12	590	Pass	0.622	Pass	
3	3.55	630	Pass	0.846	Pass	
4	2.84	540	Pass	0.385	Fail	Safely Misclassified
5	4.03	570	Pass	0.904	Pass	

➢Sensitivity: proportion of students who passed the class that are correctly identified as such
➢Specificity: proportion of students who failed the class that are correctly identified as such
➢1-sensitivity (false negative): proportion of students who predicted to fail the class but passed
➢1-specificity (false positive): proportion of students who predicted to pass the class but failed

Predicted outcome changes for different cutoff values.

Area Under the Curve (AUC) of the Receiver Operating Characteristics (ROC) indicated that the model has a fairly good discriminant performance.
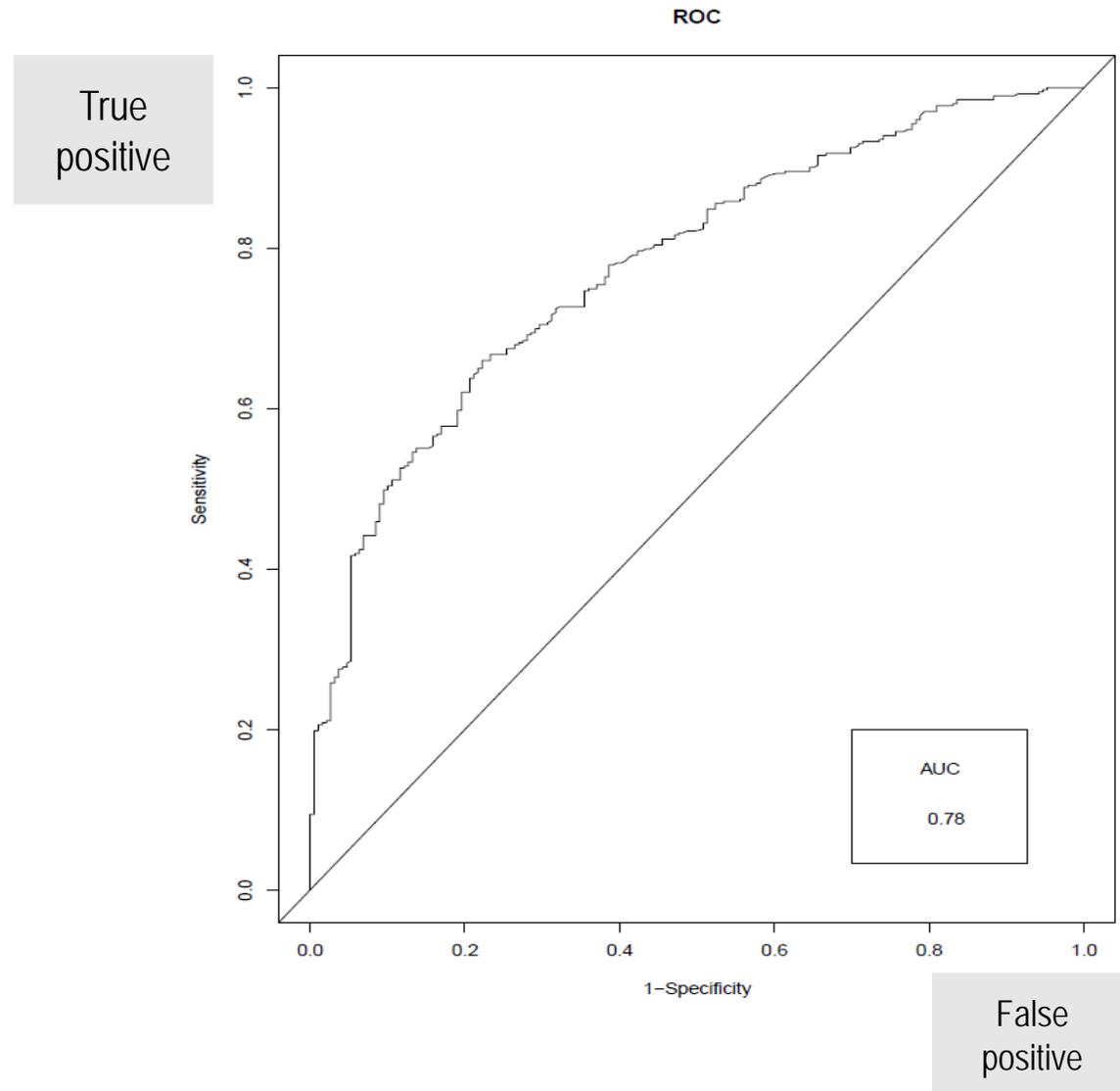
Predicted probability of passing Math 113 as a function of math SAT and different categories of high school GPA

Proposed Math 113 Placement Criteria:

[(HSGPA ≥ 3.5) AND (SAT ≥ 500)]

OR (SAT ≥ 570)

OR (ALEKS 46 – 69)

GPA ≥ 3.5 & SAT >500

4.0 ≤ GPA
3.5 ≤ GPA < 4.0
3.3 ≤ GPA < 3.5
3.0 ≤ GPA < 3.3
2.5 ≤ GPA < 3.0

level   * * * 1   ⊖ ⊖ ⊖ 2   + + + 3   + + + 4   + + + 5

Placement of GE B2 courses

ESM PPL ≥ 46	ESM PPL < 46	Calculus PPL ≥ 80	Calculus PPL ≥ 70
Without co-requisite	With co-requisite	Engineering Calculus 1	Biology Calculus 1

ESM PPL ≥ 46 — Without co-requisite:
- Quantitative Reasoning
- Intro to Stats
- Business Calculus, Business Statistics, Liberal Studies Math
- 1-semester Pre-Calculus Algebra

[(HSGPA ≥ 3.5) AND (SAT ≥ 500)]

ESM PPL < 46 — With co-requisite:
- Quantitative Reasoning
- Intro to Stats
- Business Calculus, Business Statistics, Liberal Studies Math
- 1-year Pre-Calculus Algebra

←
- Explore interest during the 1st semester and get GE credit.
- Students are encouraged to switch to non-STEM concentrations if receiving C or lower.

SUMMARY AND RECOMMENDATIONS

MAPB 1

MAPB 7   MAPB 11

GE MATH
STAT 108
MATH 103

MATH 115   MATH 113   MATH 111

MATH 122

MATH 123

EO 1110 COURSE REDESIGN
2017-18

COURSE REDESIGN 2012-16

- EARLY START COMBINED WITH ADAPTIVE LEARNING IS VERY EFFECTIVE IN IMPROVING STUDENTS' PREPARATION AND PLACEMENT

- STUDENTS WHO START MATH SEQUENCE IN MAPB (PARTICULALRY STEM MAJORS) ARE AT INCREASED RISK FOR ATTRITION OR GRADUATING LATE

- FIRST MATH FRESHMAN COURSE PREDICTS MAJOR-SWITCHING PATTERNS (MAPB VS 113 VS CALCULUS)

- HS GPA AND SAT CORRELATE WITH FRESHMAN SUCCESS IN ALGEBRA

- ALEKS PPL PLACEMENT AND TARGETED SUPPORT IMPROVE STUDENT SUCCESS IN CALCULUS