

Corequisite Statistics Courses for Equitable Support of All Students

Alana Unfried
MathFest 2021



Who has access to a college-level statistics education?

- Students who complete **AP Statistics**
- Students who enter college **math-ready**
 - Can enter directly into a general education (GE) stats course
- Students who successfully complete **mathematics remediation**

Not everyone!



Who has access to a college-level statistics education?

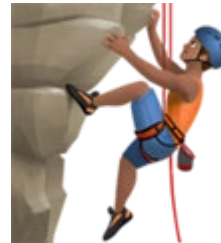
- Students who complete **AP Statistics**
- Students who enter college **math-ready**
 - Can enter directly into a general education (GE) stats course
- Students who successfully complete **mathematics remediation**

Not everyone!



Math Remediation as a Barrier to Intro Stat (and college!)

- Colleges traditionally offer **mathematics remediation** for students considered “**underprepared**” to enter a college-level mathematics or statistics course
- Nationally, **almost 2 million** students begin college in remediation each year*
- Almost 40% of college students take a remedial course**
- Remedial courses:
 - Do not count for college credit
 - Delay time to graduation
 - Are a non-starter for entry at some colleges



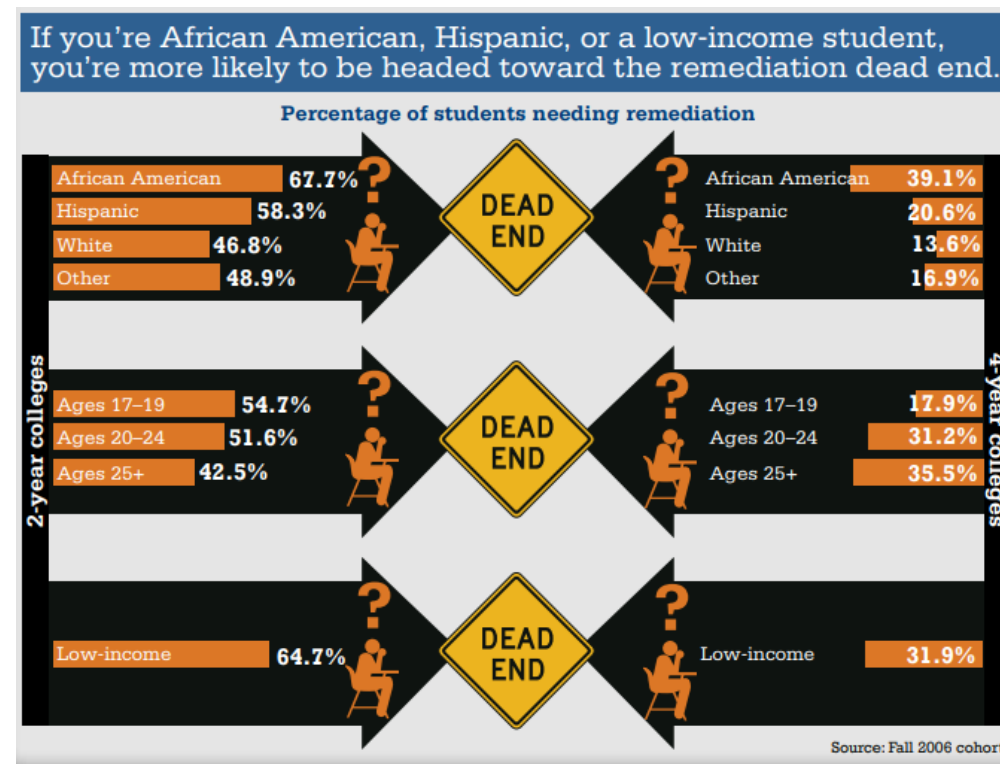
*completecollege.org/spanningthedivide/; includes English remediation; this # is dropping thanks to corequisites!

** <https://nces.ed.gov/pubs2019/2019467.pdf>

But
Remediation is
Crucial for
Success...

Right?

- At 4-year colleges only **36% of students** who begin in remediation complete the associated GE course*
 - At 2-year colleges, only **20% of students**
- **Only 17% of students** who begin in remediation will graduate*
- Evidence shows that this is due to **quitting, not failing****

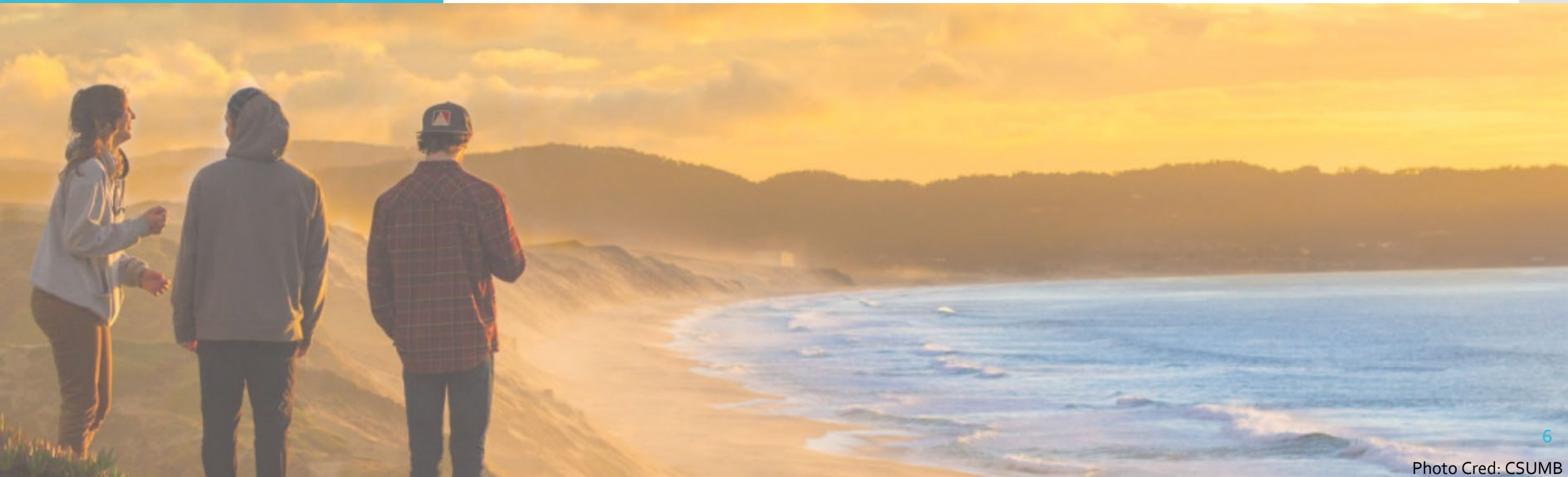


*completecollege.org/spanningthedivide/

**completecollege.org/wp-content/uploads/2017/11/CCA-Remediation-final.pdf

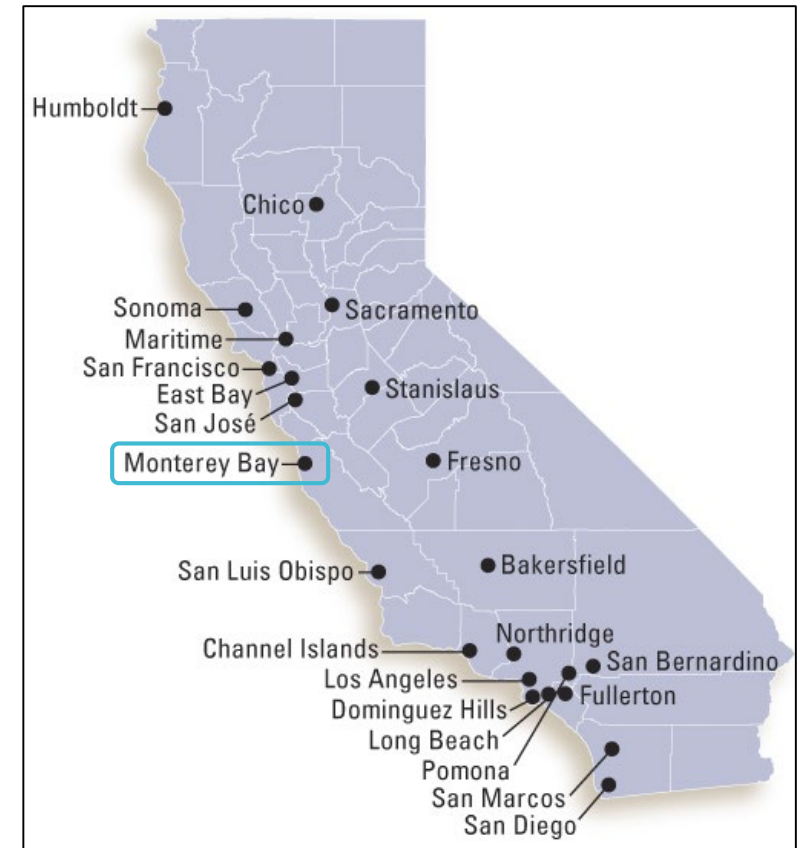
Context

California State University, Monterey Bay



CSUMB Context

- CSUMB is part of the **California State University (CSU) system**
 - 23 campuses
 - 484,000 students enrolled annually
- Around 7,500 students
- **Hispanic-Serving Institution** (45% Latinx, 29% Caucasian)
- 63% Female
- 32% age 18-20, 39% age 21-24, 17% age 25-30, 12% age 30+
- **Nationally-recognized** math remediation program!*
- **Four General Education (GE) Mathematics Courses**, based on major
 - Intro Stat
 - Finite Math
 - Quantitative Literacy
 - Pre-calculus



Math Remediation as a Barrier in the CSU*

- Close to 40% of students began in math remediation
- 4-8 units of **non-credit-bearing** coursework **before** being able to enter a GE math course
- If a student did not complete math remediation their first year, they were **dismissed from the university**
- In the CSU, this resulted in about **2,700 students** not permitted to re-enroll each year (12% of first-time freshman needing remediation)



But
Remediation is
Crucial for
Success
at CSUMB...

Right?

- Remember, we had a nationally recognized remediation program!
- At CSUMB, remediation **did not guarantee success** in Intro Stat
 - In the 2016-2017 school year...

77%

Percent of students who passed Intro Stat and did not require math remediation (n=315)

57%

Percent of students who passed Intro Stat after successfully completing math remediation (n=269)



Equity Gap!

Math Remediation Isn't Working

- So let's get rid of it
- In Fall 2017, CSU Chancellor's Office issued EO 1110:
 - GE Math/Stat must be completed in first year of college
 - No more math remediation
 - Maximum 1 unit non-credit-bearing developmental math allowed, with two possible structures
 - Stretch Course
 - **Corequisite Course**
 - Must be implemented by Fall 2018



Corequisite Courses:

Why Should We Care?

- The movement to switch to corequisite courses is **strong and growing**.
- Close to **50% of universities** have reported the removal of remedial courses.*
- The Dana Center for Math Pathways issued a Call to Action for **Expanded Access to Intro Stat** in 2015**.
- 2-year and 4-year colleges
- States that have conducted **widespread** implementation of corequisite courses *** :

California	Indiana
Tennessee	West Virginia
Georgia	Colorado

*https://completecollege.org/wp-content/uploads/2021/04/CCA_NoRoomForDoubt_CorequisiteSupport.pdf

**<https://dcmathpathways.org/sites/default/files/resources/2017-05/Call%20to%20Action%20to%20Expand%20Access%20to%20Statistics.pdf>

***completecollege.org + many more states

Corequisite
Courses:

Why Should
We Care?

More students get to experience
Intro Stat!



The Rest of This Talk

- What are corequisite courses?
- How do we implement them?
- **Do they work?**



Corequisite Course Design



What is a Corequisite Course?

- It is **not** a remedial math course.
- It is a **support course** taken alongside a college-level course.
- There are many **corequisite models**
 - **Co-mingling**: mixing college-ready and underprepared students in the same Intro Stat class. Underprepared students enroll in separate coreq course
 - **Cohorting**: designating certain sections of Intro Stat exclusively for underprepared students. Coreq material can be embedded or separate.
 - **Stretch courses**: Intro Stat with developmental content embedded, spread over two semesters (like Statway)

CSUMB Corequisite Course Structure

- **Equity:** we decided this means a **co-mingled** model
 - No stigmas about who belongs and who doesn't
- 2-hour face-to-face activity period at end of week
- 1 non-college-credit-bearing unit
- Taught by an Intro Stat faculty member
- Capped at 25 students
- Peer Mentors embedded in the coreq course
- Students graded on participation and assignment completion

100

Implications of a Comingled Model

- Each section of **Intro Stat** has students with **widely varied educational backgrounds**
 - How do we help **everyone** have a positive experience?
- Each section of the **coreq** has students from **multiple sections of the GE Intro Stat course**
 - GE course must be **highly coordinated** so all students are learning same material at same pace
 - **Course coordinator**: 2 units of release time each semester
 - Coreqs scheduled on **Thursdays and Fridays** so they have completed the full week of Intro Stat before coming to the coreq

Who Enrolls in the Corequisite?

- **Any** Intro Stat student can enroll in the corequisite
- Incoming freshman students complete **Directed Self-Placement (DSP)**, a short diagnostic giving students agency to determine if they think they should take the coreq or not.
 - Evidence-Based
 - Reflective Experience
- The CSU system gives a **multiple-measures placement** based on metrics such as high-school math GPA, ACT/SAT, etc.
- Around **22%** of Intro Stat students enrolled in the coreq



The Corequisite Class Period

Three Components

Corequisite Math Knowledge

Support for Course Content

Study Skill Development

Corequisite Math Knowledge

- *Mathematics Prerequisites for Success in Introductory Statistics*
 - Roxy Peck, Rob Gould, and Jessica Utts
- We use **EdReady** to give students practice on math prerequisites

- Online, adaptive learning
- Students start with a diagnostic quiz and work towards 90% proficiency

56 ●————●90	02:21:36	90
70 ●————●92	02:35:33	90
58 ●————●84	00:00:00	90
52 ●————●96	00:00:00	100
34 ●————●90	00:00:00	90
30 ●————●90	00:54:39	100
60 ●————●70	00:31:21	90
70 ●————●90	00:00:00	90

Support for Course Content

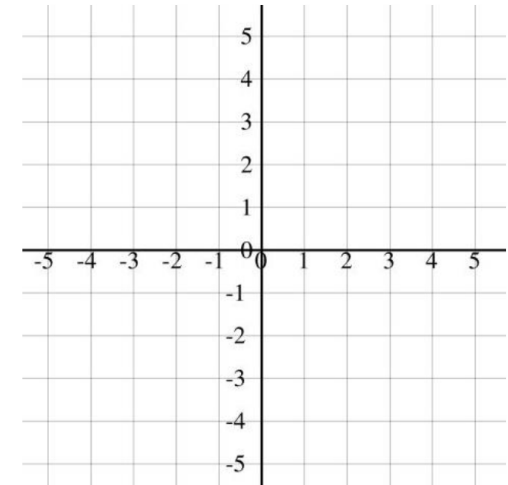
- Group Work
- Active Tasks
- Worksheets
- Mini-Lectures
- Test Corrections
- Open Work Time

Use the following equation to answer questions 10 through 15. $y = 3x - 2$

1. Fill out the following chart to calculate y for given values of x .

x	y
-1.0	
0.0	
1.0	
1.5	
2.0	

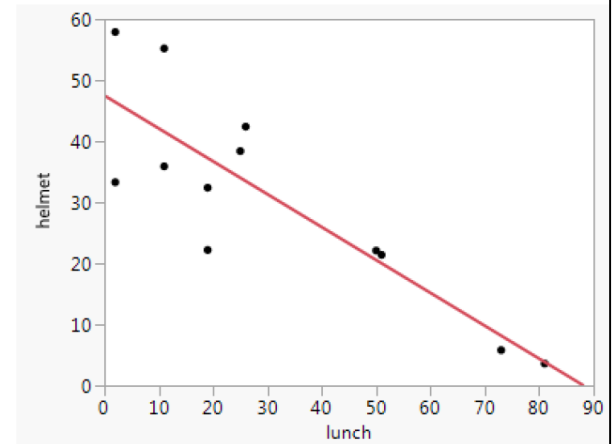
2. On the graph to the right, plot the equation $y = 3x - 2$. Use the chart from question 10 to help you.
3. On the graph, label which axis is the y axis and which is the x axis.
4. Using the equation and the graph to guide you, interpret the meaning of slope.



Support for Course Content

Use the following to answer questions 8 through 26.

The scatterplot shows the relationship between socioeconomic status measured as the percentage of children in a neighborhood receiving reduced-fee lunches at school (lunch) and the percentage of bike riders in the neighborhood wearing helmets (helmet). The average percentage of children receiving reduced-fee lunches is 30.8% with a standard deviation of 26.7% and the average percentage of bike riders wearing helmets is 38.8% with a standard deviation of 16.9%. The JMP output below shows correlation and regression results for this data.



8. Which variable (lunch or helmet) has more variability? How do you know?

9. In this scenario, which is the response variable and which is the explanatory variable?

10. What is a case in this dataset?

Linear Fit
helmet = 47.490446 - 0.5386091*lunch

Summary of Fit

RSquare	0.721253
RSquare Adj	0.693378
Root Mean Square Error	9.384827
Mean of Response	30.88333
Observations (or Sum Wgts)	12

Lack Of Fit

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	2278.9268	2278.93	25.8748
Error	10	880.7499	88.07	Prob > F
C. Total	11	3159.6767		0.0005*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob> t
Intercept	47.490446	4.242456	11.19	<.0001*
lunch	-0.538609	0.105885	-5.09	0.0005*

Bivariate Normal Ellipse P=0.950

Variable	Mean	Std Dev	Correlation	Signif. Prob	Number
lunch	30.83333	26.72361	-0.84927	0.0005*	12
helmet	30.88333	16.94825			

Study Skill Development

- [The Myth of "I'm Bad at Math"](#)
- Time Management Workshop
- Organization Skills
- Test Anxiety Workshop
- Practice with Multiple Choice Exam Questions
- Strategies for Preparing for Exams



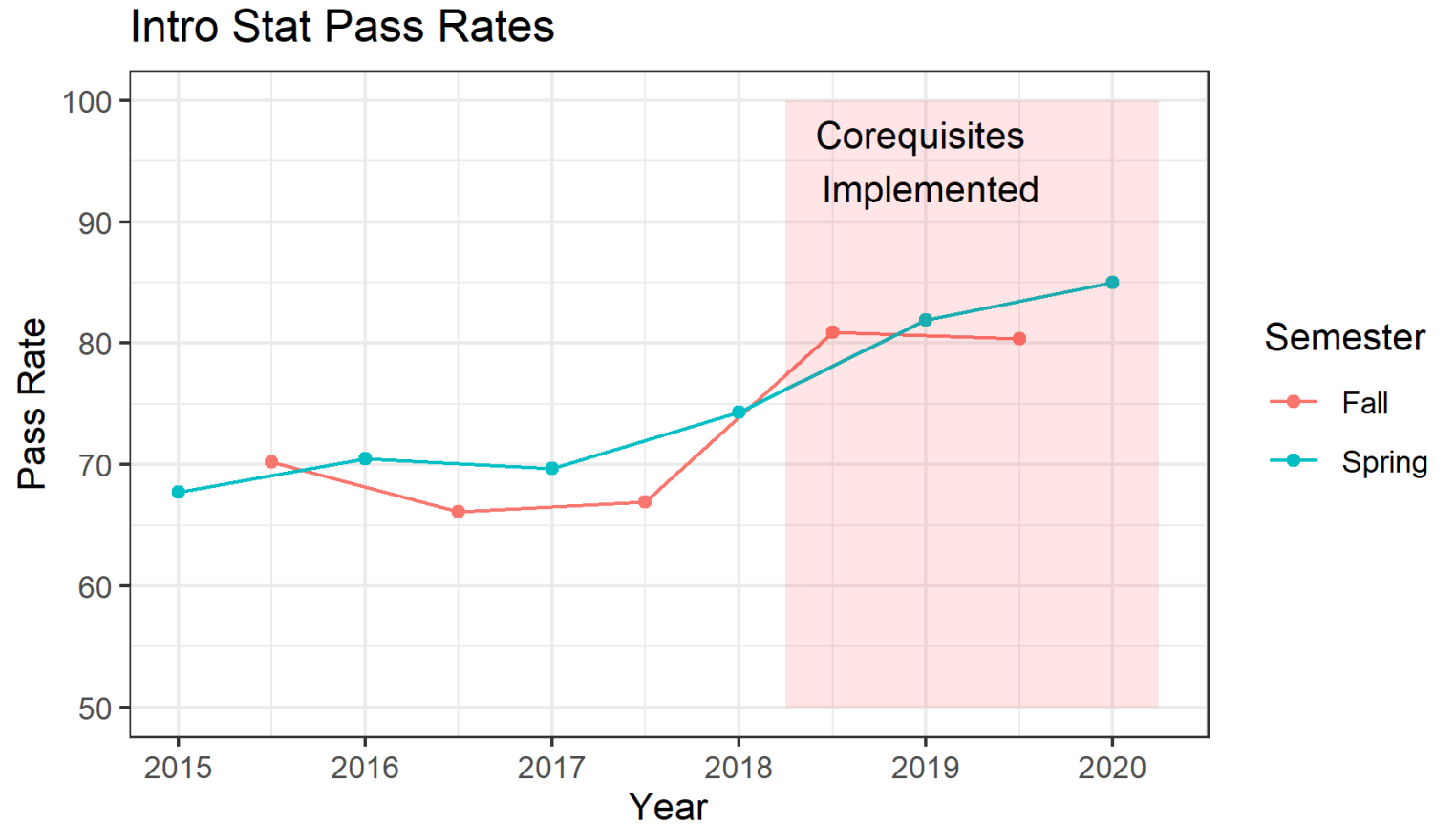


Results

Did this work??

Intro Stat Pass Rates

- Our goal: **maintain** our Intro Stat pass rates.
- What actually happened:



- Overall pass rates went **up!!!**

Intro Stat Pass Rates:

Historical Remediation Data

Are “remediated” students successful in Intro Stat?

	Pass Rate: Remediation	Pass Rate: No Remediation	Equity Gap
Fall 2016	48% (n=144)	80% (n=189)	32%
Spring 2017	66% (n=125)	73% (n=126)	7%
Fall 2017	58% (n=99)	79% (n=215)	21%
Spring 2018	61% (n=87)	84% (n=119)	23%
TOTAL	58% (n=455)	79% (n=649)	21%

- **Pass Rate: Remediation** shows Intro Stat pass rates for students who had previously completed math remediation.
- **Pass Rate: No Remediation** shows Intro Stat pass rates for students who were never required to take math remediation.

Intro Stat Pass Rates:

Comparing
Corequisite vs
No-Corequisite

Are corequisite-enrolled students successful in Intro Stat?

	Pass Rate: Remediation	Pass Rate: No Remediation	Equity Gap
2016-18	58% (n=455)	79% (n=649)	21%
	Pass Rate: Corequisite	Pass Rate: No Corequisite	Equity Gap
Fall 2018	83% (n=65)	80% (n=163)	-3%
Spring 2019	87% (n=54)	80% (n=173)	-8%
Fall 2019	75% (n=38)	82% (n=138)	7%
Spring 2020*	83% (n=39)	85% (n=238)	2%
TOTAL	82.3% (n=196)	82.2% (n=712)	-0.1%

- **Pass Rate: Corequisite** shows Intro Stat pass rates for students who also enrolled in the corequisite course.
- **Pass Rate: No Corequisite** shows Intro Stat pass rates for students who did not enroll in the corequisite course.
- Keep in mind most students self-selected into the corequisite course

*COVID Semester!

Intro Stat Pass Rates

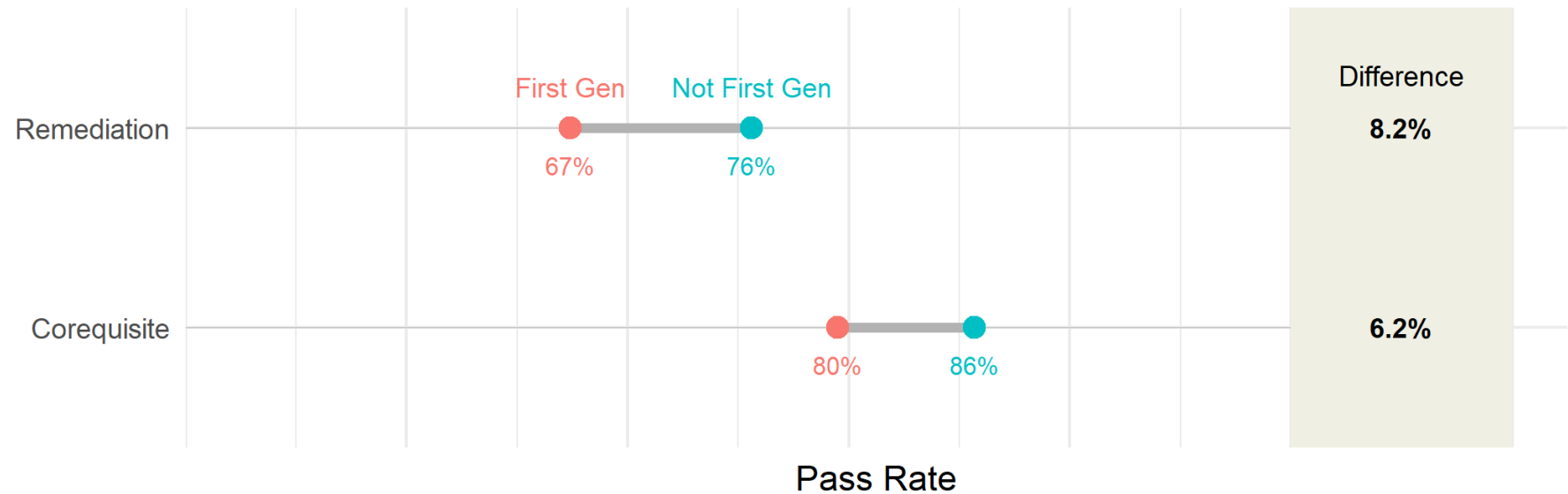
Are “non-supported” students successful in Intro Stat?

	Pass Rate: Remediation	Pass Rate: No Remediation	Equity Gap
2016-18	58% (n=455)	79% (n=649)	21%
	Pass Rate: Corequisite	Pass Rate: No Corequisite	Equity Gap
2018-20	82.3% (n=196)	82.2% (n=712)	-0.1%

- Even pass rates for non-supported students (no corequisite) have improved
 - Due to changes in our Intro Stat course
 - “Non-Supported students” includes students who traditionally would have been required to complete remediation, but did NOT choose to enroll in the corequisite.

First Generation Equity Gaps

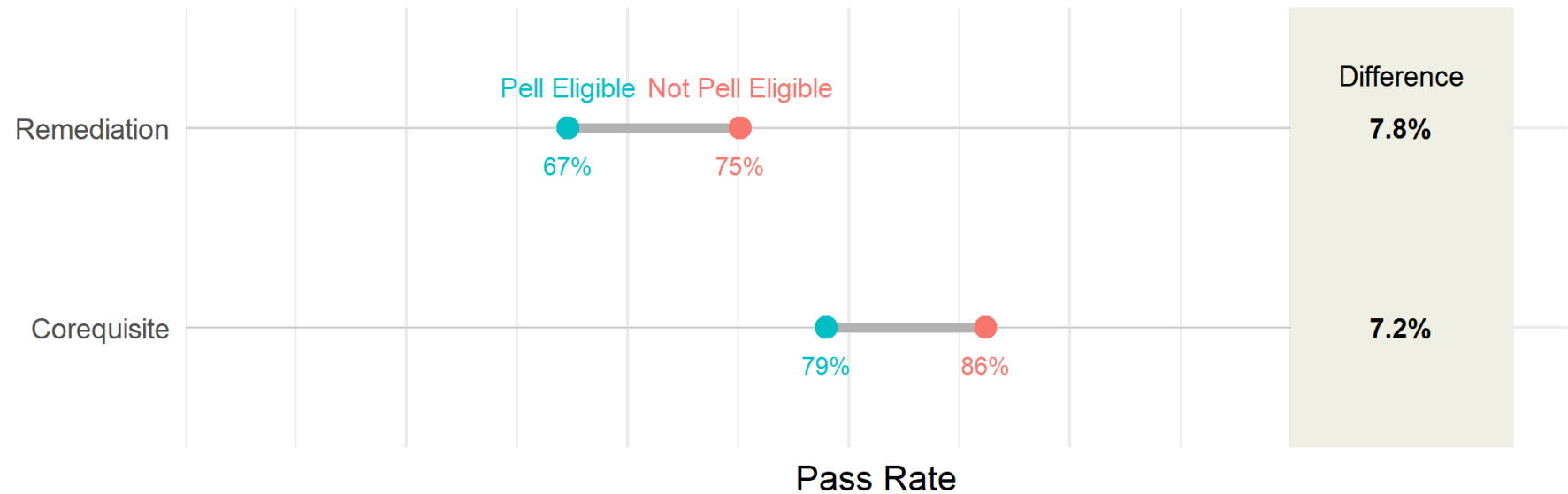
First Generation Student Pass Rate Equity Gaps in Intro Stat *Comparing Remediation and Corequisite Models*



Remediation Data from Fall 2015 to Spring 2018
Corequisite Data from Fall 2018 to Spring 2020
Data for First-Time Freshmen Only
Sample Sizes vary from around n=400 to n=800

Pell Eligibility Equity Gaps

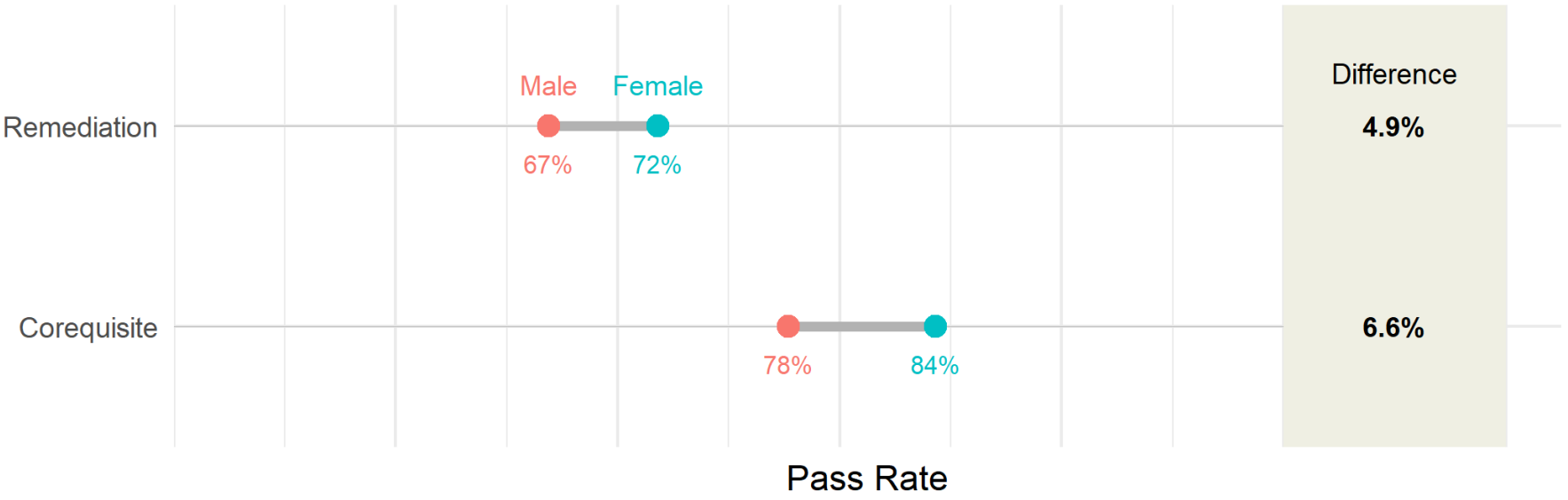
Pell Eligible Student Pass Rate Equity Gaps in Intro Stat *Comparing Remediation and Corequisite Models*



Remediation Data from Fall 2015 to Spring 2018
Corequisite Data from Fall 2018 to Spring 2020
Data for First-Time Freshmen Only
Sample Sizes vary from around n=400 to n=800

Male/Female Equity Gaps

Male/Female Student Pass Rate Equity Gaps in Intro Stat *Comparing Remediation and Corequisite Models*



Remediation Data from Fall 2015 to Spring 2018
Corequisite Data from Fall 2018 to Spring 2020
Data for First-Time Freshmen Only
Sample Sizes vary from around n=300 to n=1000

Other Notes

- **Considerations:**
 - We fully revised Intro Stat, so we can't say the changes are solely due to the corequisite.
 - Students self-placed into corequisite course, so different population than remedial math courses
- **We are Still Researching:**
 - How does corequisite attendance relate to course outcomes?
 - Do students from different demographic groups have different course experiences?
 - What happens in subsequent statistics courses?
 - Do attitudes toward statistics differ after implementing complex instruction and corequisites?
 - SATS survey data collected since Fall 2017

It's A Lot

- Switching to a corequisite model is **a lot of work**
- Parties involved include administration, admissions, registrar, institutional assessment, advising, student services, faculty, and of course, students
- We had extensive **professional development and financial support** from the CSU Chancellor's Office
- I do not recommend a one-year timeline 🤪

Next Steps for YOU

- **Check your equity gaps** for Intro Stat (and for all your other courses, too...)
- **If your college offers math remediation:**
 - Check your pass rates in subsequent courses.
 - What percent of students never make it out of remediation?
 - Switch to a coreq model!
- **If students must enter directly into college math:**
 - Consider adding a coreq course to Pre-Calculus, Calculus, Intro Stat, etc, to increase student success.

Believe that any student can succeed in stats, no matter what level of math background they have.

Thank You!

Alana Unfried

aunfried@csumb.edu

Special thanks to my CSUMB colleagues Judith Canner, Peri Shereen, Jeffrey Wand, Jennifer Clinkenbeard, Alison Lynch, Joanne Lieberman and Steven Kim, all of whom have contributed to this work.



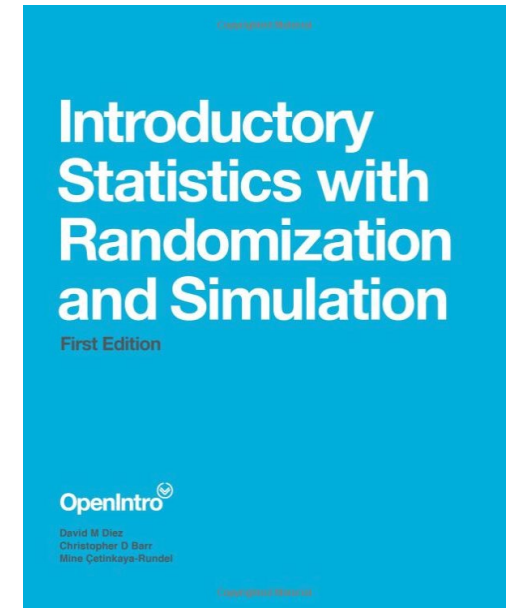
Extras

Corequisite Grading Structure

- Classroom Assignments and Attendance (65%)
 - Come to class
 - Stay the whole time
 - Do the work
 - Engage with your group
- Online Mathematical Skills Development (35%)
 - EdReady
- We give them a letter grade during the semester...
- Pass/Fail Relationships
 - Your grades in the coreq and GE courses are independent
 - If you fail the GE, you are “required” to take the coreq next time
 - You can retake the coreq, even if you already passed it (administrative hurdle)

Intro Stat Logistics

- Typically enroll 500-600 students per academic year
- Capped at 36 students per section
 - Cap was 65 prior to the corequisite model
 - CSUMB does not have grad student instructors, recitation sections, etc
- 3-unit class, meets 2 days a week for 80 minutes
- In-person
- Course coordinator oversees all course materials, schedule, exams, etc
 - Weekly meetings with all instructors
- We emphasize low-cost/free resources
- JMP Statistical Software (we have a campus license)
- Use **complex instruction** as pedagogy



What is Complex Instruction?

Complex Instruction is a combination of pedagogical strategies used to create a **classroom 'social system'** that directly attends to problems of **social inequality**, which **undermine academic access and achievement** if left unexamined*

- Widely developed in secondary mathematics
- Disrupt typical hierarchies of **who is "smart"** and **who is "not"****
- **More info on how we implemented it [here](#)**

*Source: Lisa Jilk, 2009, personal communication

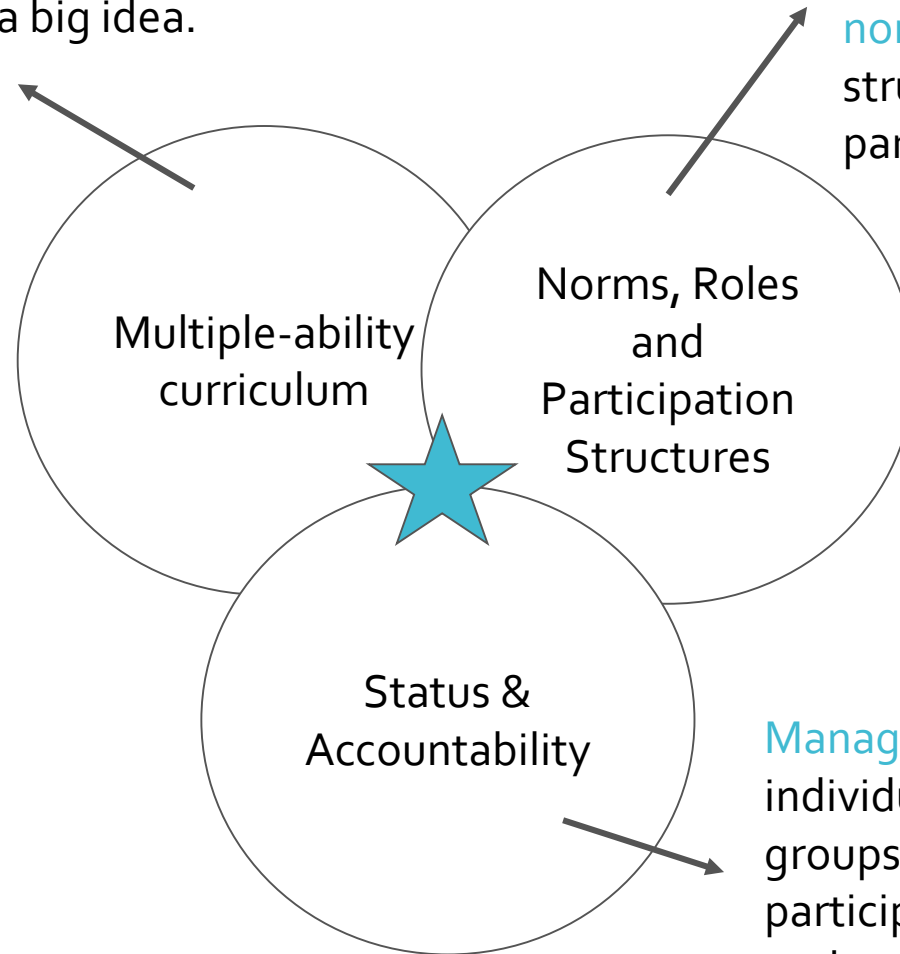
**Sapon-Shevin, 2004; Introduction from "Teaching Cooperative Learning: The Challenge for Teacher Education"

CI originally developed by Cohen and Lotan

Complex Instruction

Provide curricular activities that are **open-ended**, rich in **multiple abilities**, and **support learning** important math concepts and skills central to a big idea.

Develop **autonomy** of and interdependence of **small groups** through the use of **norms, roles** and other structures of participation



Manage status and hold individuals and small groups **accountable** for participation and understanding.

Teaching Online

- We did not offer Intro Stat online until COVID struck
- Our general finding is that corequisite students benefit from in-person support, and in-person classes
- We may offer 1 or 2 sections online moving forward, but CI was not as successful for us in the online context
- Course structure:
 - Interactive Videos
 - Group work online 2x a week
 - Perusall for online reading assignments
 - Mini-exams every 3 weeks