# Expanding Opportunities for Underprepared Statistics Students

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USCOTS 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!**



*All emojis from Apple

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🙅‍♂️

🤔

# Why are we talking about math remediation at a statistics conference?

And, why should you keep listening even if your school doesn't offer remedial courses?

# 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
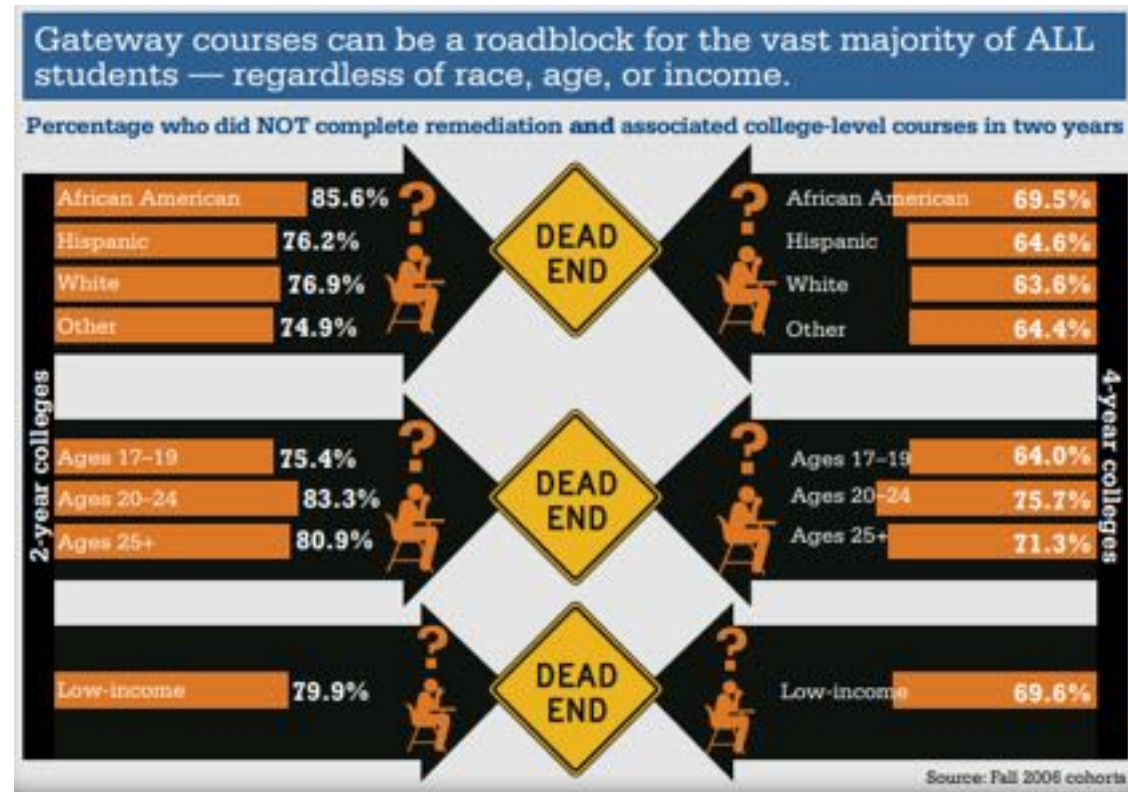  - Are a non-starter for entry at some colleges

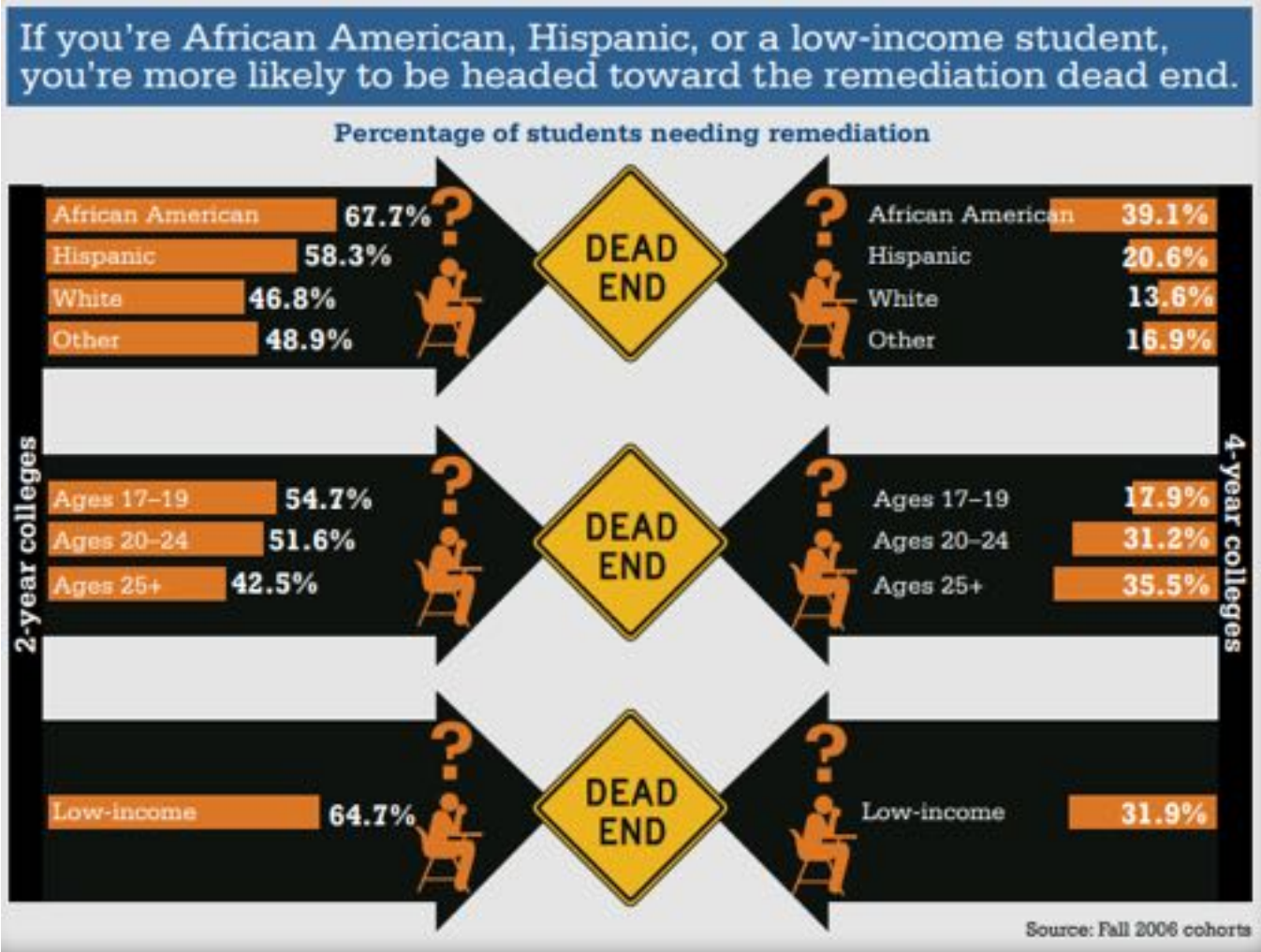## But Remediation is Crucial for Success…

## 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****



Gateway courses can be a roadblock for the vast majority of ALL students — regardless of race, age, or income.

Percentage who did NOT complete remediation and associated college-level courses in two years

| 2-year colleges | | 4-year colleges | |
|---|---|---|---|
| African American | 85.6% | African American | 69.5% |
| Hispanic | 76.2% | Hispanic | 64.6% |
| White | 76.9% | White | 63.6% |
| Other | 74.9% | Other | 64.4% |
| Ages 17–19 | 75.4% | Ages 17–19 | 64.0% |
| Ages 20–24 | 83.3% | Ages 20–24 | 75.7% |
| Ages 25+ | 80.9% | Ages 25+ | 71.3% |
| Low-income | 79.9% | Low-income | 69.6% |

Source: Fall 2006 cohorts

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

# Who "Needs" Remediation?



If you're African American, Hispanic, or a low-income student, you're more likely to be headed toward the remediation dead end.

Percentage of students needing remediation

2-year colleges

| | |
|---|---|
| African American | 67.7% |
| Hispanic | 58.3% |
| White | 46.8% |
| Other | 48.9% |

| | |
|---|---|
| Ages 17–19 | 54.7% |
| Ages 20–24 | 51.6% |
| Ages 25+ | 42.5% |

| | |
|---|---|
| Low-income | 64.7% |

4-year colleges

| | |
|---|---|
| African American | 39.1% |
| Hispanic | 20.6% |
| White | 13.6% |
| Other | 16.9% |

| | |
|---|---|
| Ages 17–19 | 17.9% |
| Ages 20–24 | 31.2% |
| Ages 25+ | 35.5% |

| | |
|---|---|
| Low-income | 31.9% |

DEAD END

Source: Fall 2006 cohorts

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

# Context

California State University, Monterey Bay

Photo Cred: CSUMB
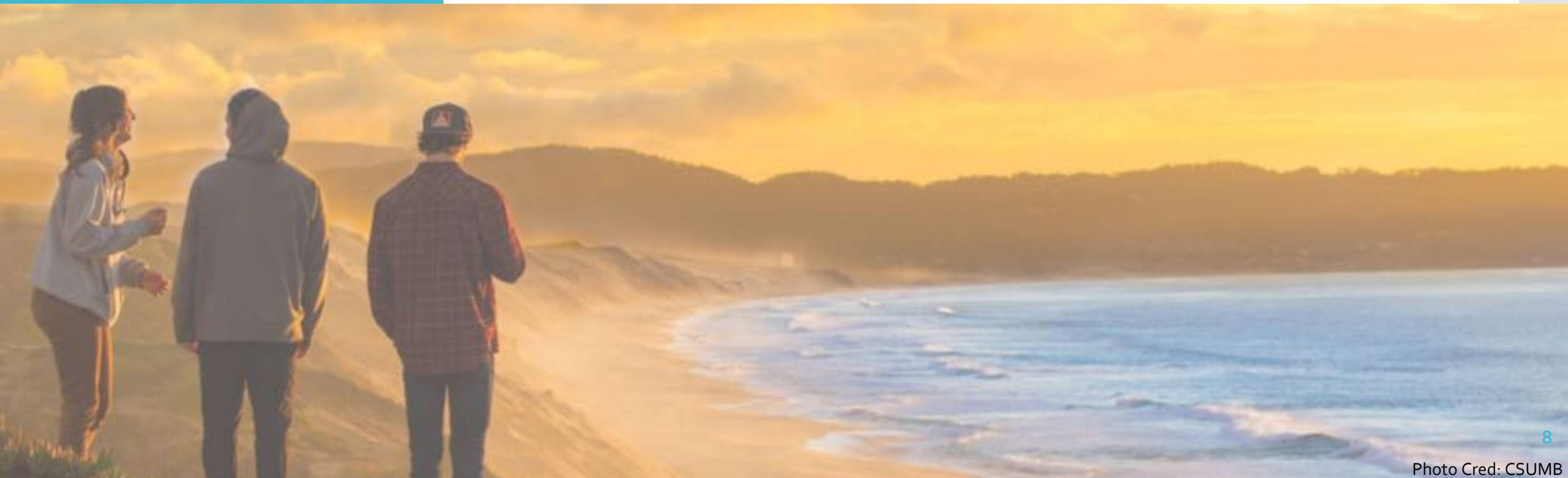
## CSUMB Context

- CSUMB is part of the **California State University (CSU) system**
  - 23 campuses
  - 484,000 students enrolled annually
- **Nationally-recognized** math remediation program!*
- 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+
- **Four General Education (GE) Mathematics Courses**, based on major
  - Intro Stat
  - Finite Math
  - Quantitative Literacy
  - Pre-calculus

*https://csumb.edu/news-migrated/csumb-awarded-8-million-innovation-grants/

# 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)

😱

*http://asd.calstate.edu/performance/remrates/16-17/systemwide.htm
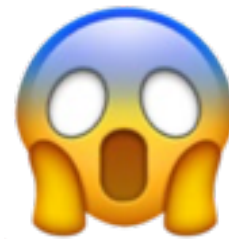
# But Remediation is Crucial for Success at CSUMB…

## 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**.

- 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?

- 2-year **and** 4-year colleges
- **Textbooks**:
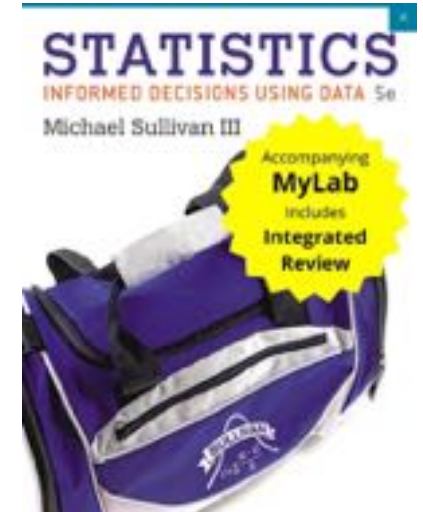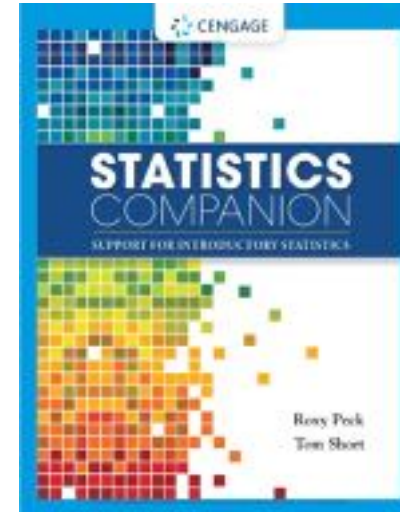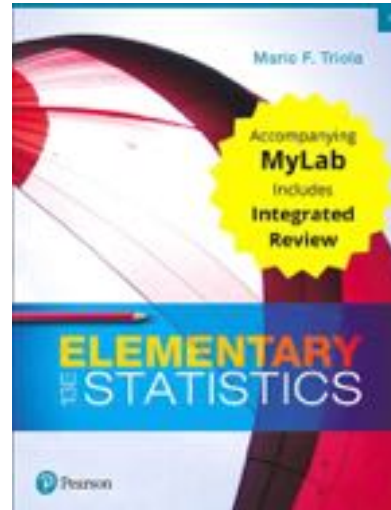
# Corequisite Courses:

# Why Should We Care?

More students get to experience Intro Stat!

*Expanding Opportunities…*

👏

# But…

# Why Me?

# Why You?

- ***"I don't want to teach remedial math"*** 😬
  - That was me
  - Now I have "remedial" students in Intro Stat
  - But I'm not teaching remedial math!
    - I'm teaching math needed for stats
  - **Millions** of students will be taking an Intro Stat corequisite course.
    - Don't we want the statistics education community to **lead the way**?

- ***"My school doesn't have remedial students"*** 🥱
  - Why not?
  - Check your equity gaps
    - Would any of your students benefit from additional support?

# The Rest of This Talk

## Corequisite Courses

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

## Complex Instruction

- Pedagogy that can be used in **any** class.
- Underprepared students are now enrolled in Intro Stat!
- How do I help **underprepared AND prepared** students succeed?

# 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

💯

# 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?

- **Historically, who used to enroll in math remediation?**
  - For CSUMB, any student with a low math placement exam score
  - Even if they had met HS graduation requirements for math courses

- **Now, 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 form 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.
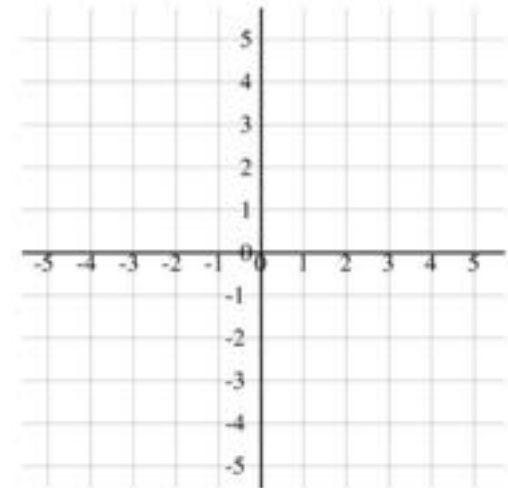
# Support for Course Content

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?
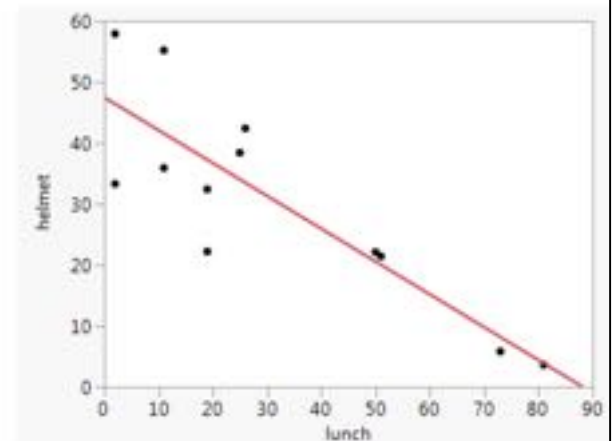


**Linear Fit**

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 | | | |

*Scenario from OpenIntro textbook

# 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

🤓

# What do Students Think of the Coreq?

Student Quote:

*I know a lot of people in my [Intro Stat] class that said "Oh my god how are you not in [the support] class, it is so useful!"*

😎

# The Challenge

Now I have mathematically underprepared students in my Intro Stat course!

Alongside students who have taken AP Stat.

How do I help **all** of my students succeed without reducing the "rigor" of the course?

🤔

# Complex Instruction

## Which pedagogy?

**Our goal was to provide:**
**Instructors** with the tools to develop each student's sense of belonging
and
**Students** with tools to be successful learners.

Teacher

Manage

Student

Content

## Complex Instruction

Horn, I. (2012). *Strength in numbers: Collaborative learning in secondary mathematics*. Reston, VA: National Council of Teachers of Mathematics.
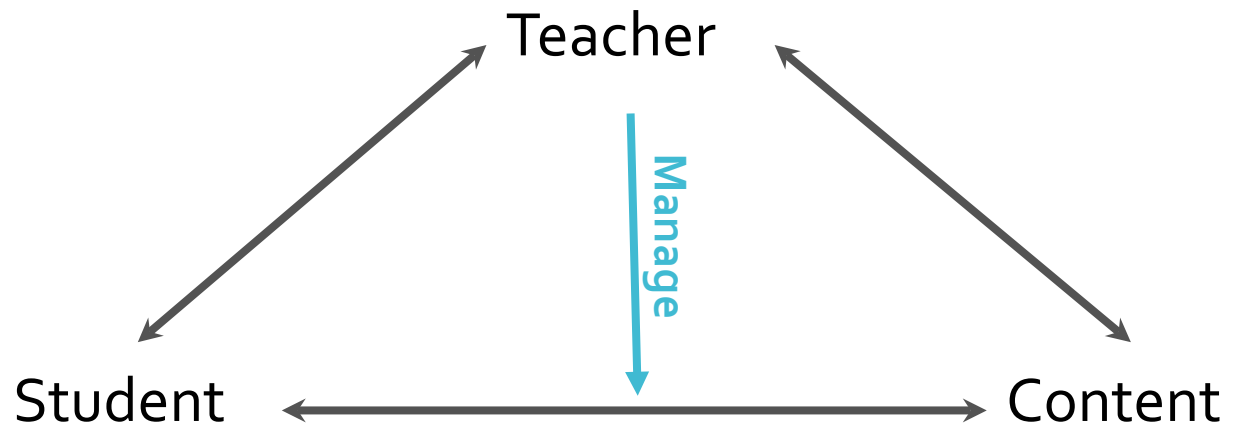
# What is Complex Instruction?

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"****

# 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



Multiple-ability curriculum

Norms, Roles and Participation Structures

Status & Accountability

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

Source: Lisa Jilk, 2009

33

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# Class Norms

## How we learn together

- No one is done until everyone is done.

- You have the right to **ask anyone in your group for help**

- You have the duty to **assist anyone** in your group who asks for help

- Helping peers means explaining thinking, not giving answers or doing work for others

- Provide justification when you make a statement

- Only ask the instructor when it's a **team question**

- Think and work together. Don't divide up the work.

- Work within your group - **no crosstalk with other groups**.

- **No one is as smart as all of us together!**

## Participation Structures

- Instructor **randomly assigns groups** of 3-4 students
  - Why? Each student is equally capable! Also avoids isolation, stops students from grouping by perceived ability.

- **Re-randomize groups** about every three weeks
  - Why? Broaden students' network. Don't let unproductive patterns linger.



36
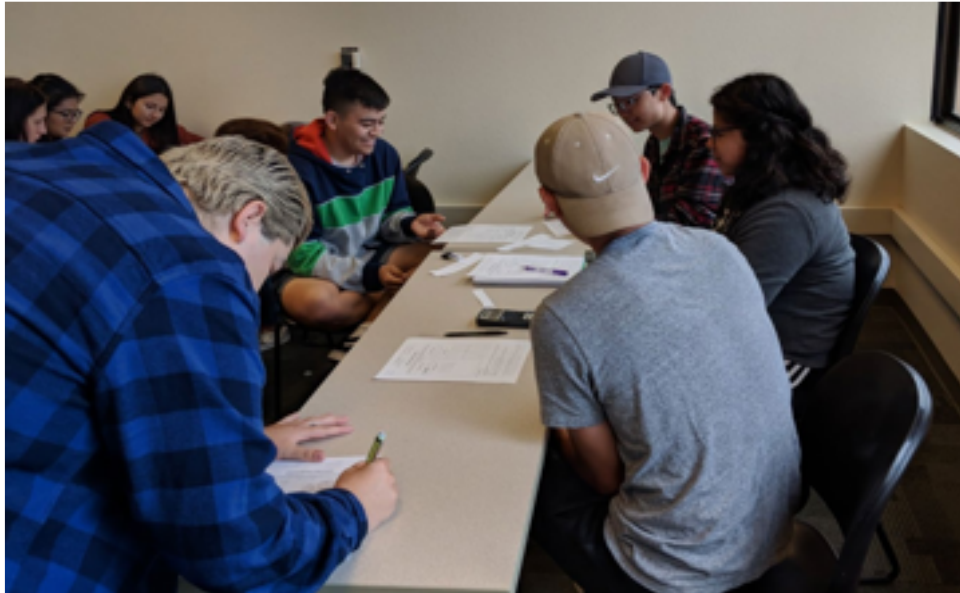
# Roles

- Each group member has a randomly-assigned **role**
- Roles relate to **how** the work should be done

| Facilitator | Recorder/Reporter |
|---|---|
| **Manages team progress through task** | **Manages communications** |
| Get the team off to a quick start<br>Make sure everyone understands the task<br>Check in with members and keep the group moving | Make sure everyone is recording ideas<br>Make sure everyone is ready to present something statistical |
| *Who knows how to start?*<br>*Does everyone get what to do?*<br>*I don't understand this yet; can someone help me?*<br>*We need to keep moving.*<br>*Is everyone ready to move on?* | *Did everyone get that in their notes?*<br>*Are we ready for our presentation?*<br>*Does everyone understand what to write down?* |
| **Resource Manager** | **Team Captain** |
| **Manages team resources** | **Manages team participation** |
| Call the professor over for **team questions only**<br>Ensure that everyone undstands team questions<br>Collect team supplies and organizes clean-up | Encourage participation; find compromises<br>Enforce norms<br>Substitute for absent roles |
| *I think we need more information.*<br>*I'll call the professor over*<br>*We need to clean up. Can you do __ while I do __?*<br>*Do we all have the same question?* | *No talking outside our team.*<br>*Let's find a way to work this out.*<br>*Can you explain your idea? Why did you do that?*<br>*Can you slow down so we can think about this together?* |

# 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
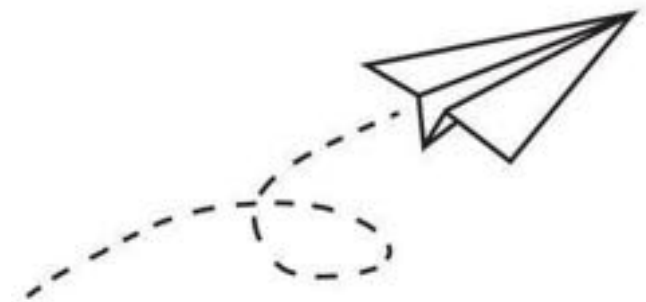
Multiple-ability curriculum

Norms, Roles and Participation Structures

Status & Accountability
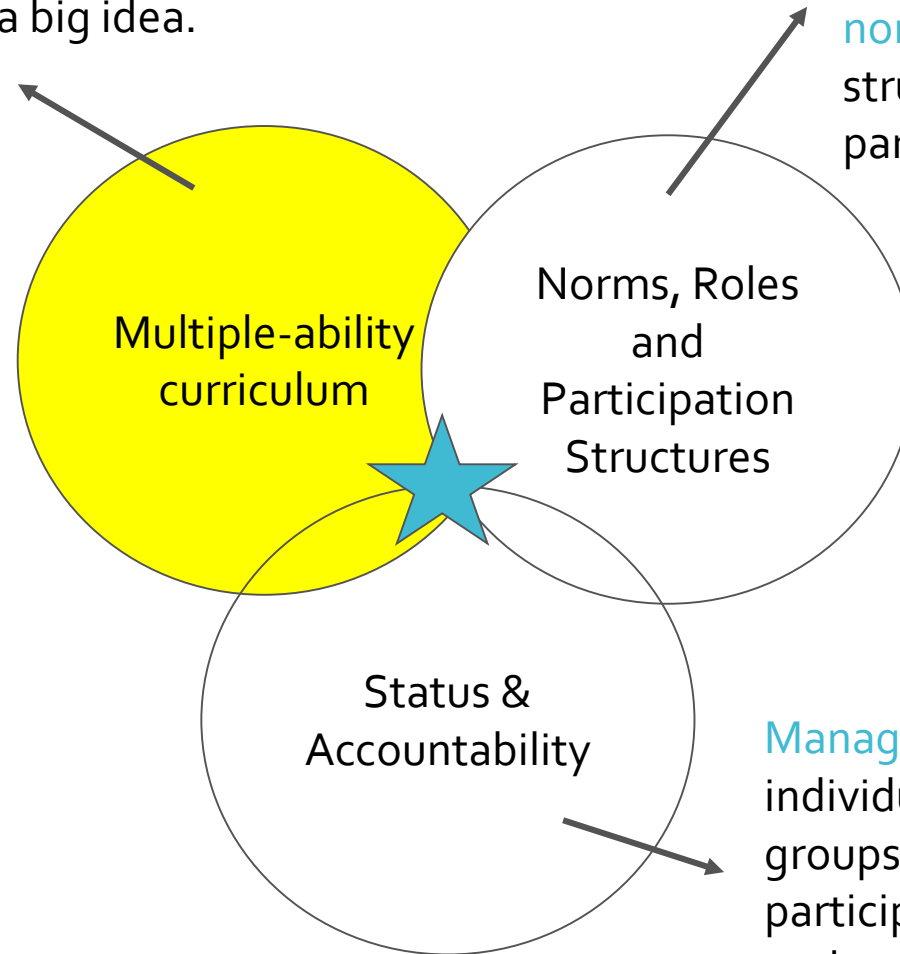
Manage status and hold individuals and small groups accountable for participation and understanding.

# Multiple-Ability Curriculum

## What inspires groups to rely on each other and utilize their roles?

- **Groupworthy Tasks!**
  - Open-ended, uncertain tasks
  - Multiple entry points; tasks requires multiple abilities to complete
  - Intellectually important content

- **Example:** Groups must follow an experimental protocol to compare paper airplane flights with and without a paperclip. They collect data, enter into the computer, and analyze.
  - Attention to detail
  - Airplane construction
  - Measurement
  - Data entry and organization
  - Spreadsheet knowledge
  - Utilizing statistical software
  - Time management

- **Each student becomes both a teacher and a learner**

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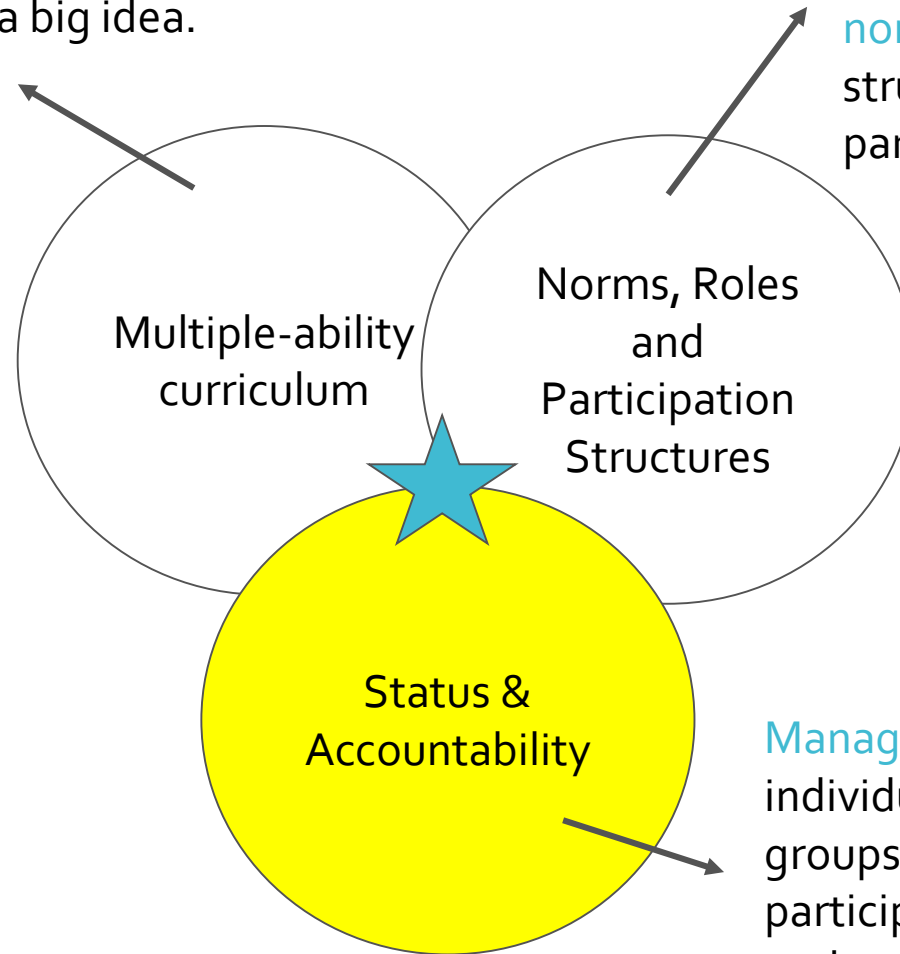
Manage status and hold individuals and small groups accountable for participation and understanding.

# Status and Accountability

- Two students walk into class, giving off the following "vibes":



- Which student will a group probably expect to be more intellectually competent?

- These judgments are based on **status characteristics**
  - **Skin color, gender, age, accent, etc.**

- If status is not managed, you will have **unequal participation**
  - Students with low status, considered less "smart," will participate and learn less

## Status and Accountability

### How do we manage status?

- **Randomize groups**: all students equally capable

- **Roles** manage assumptions of competence
  - Not just "*you will be good at the coding*"

- **Multiple abilities** needed to solve a problem
  - Not just "*how fast can you calculate that*"
  - Every student has something to contribute to the group

- **Assign Competence**: figure out **how** your students are smart and tell them **out loud**! Examples:
  - Referencing your notes and/or reading log
  - Expressing confusion over 2 key concepts
  - Writing down what you tried
  - Sharing your method out loud
  - (NOT just solving the problem!)

# 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)

**Introductory Statistics with Randomization and Simulation**
First Edition

OpenIntro
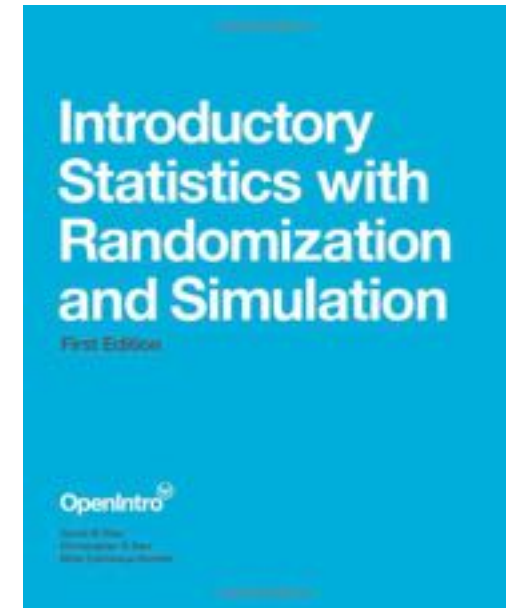
# A Typical 80-minute Class Period

| Time | Event |
| --- | --- |
| 5 Minutes | Students switch groups, I check reading logs |
| 15 Minutes | Mini-lecture on what students read in preparation for today, or covering something missing from the book |
| **45 Minutes** | **Group activity to explore the concepts*** |
| **10 Minutes** | **Activity summary, groups report answers to select questions** |
| 5 Minutes | Reading log questions, assign HW |

*My job as "manager" during this time is really important! Monitor groups. Assign Competence. Ask Questions.

# Is the course still "rigorous" enough?

## (Student Opinion)

## How challenging did you find the course material?



18%    82%

Percentage

Response  Very easy  Somewhat easy  Somewhat challenging  Very challenging
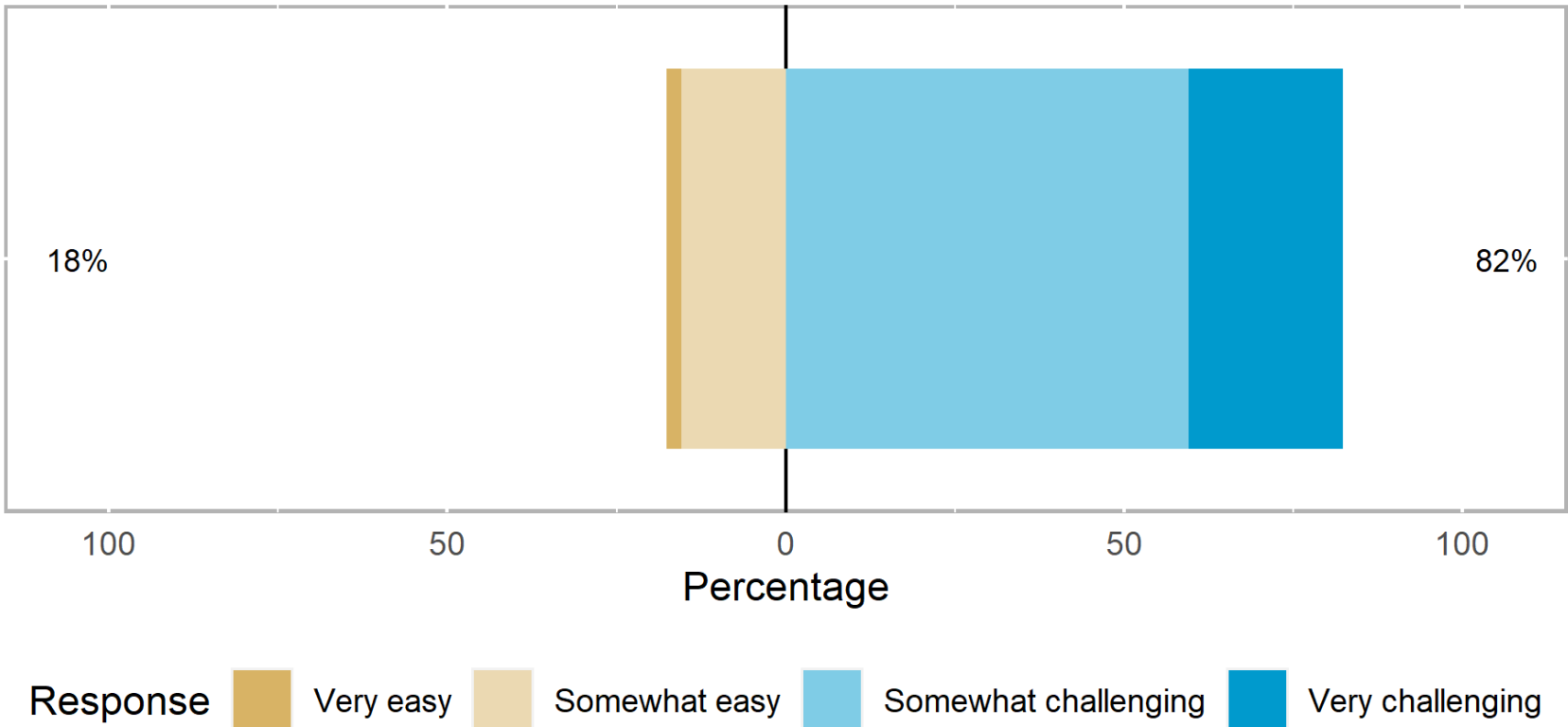
*From Student Experience Survey, given each semester, aggregated across Fall 2018 – Spring 2020. 62% of students consented to research study, and overall 37% of students answered this question and consented.

# What do Students Think of Complex Instruction?

The class environment created by my professor was supportive:  5%  95%

I was able to contribute to group discussions in class:  16%  84%

I benefited from working with my peers during class activities:  13%  87%

Percentage

100    50    0    50    100
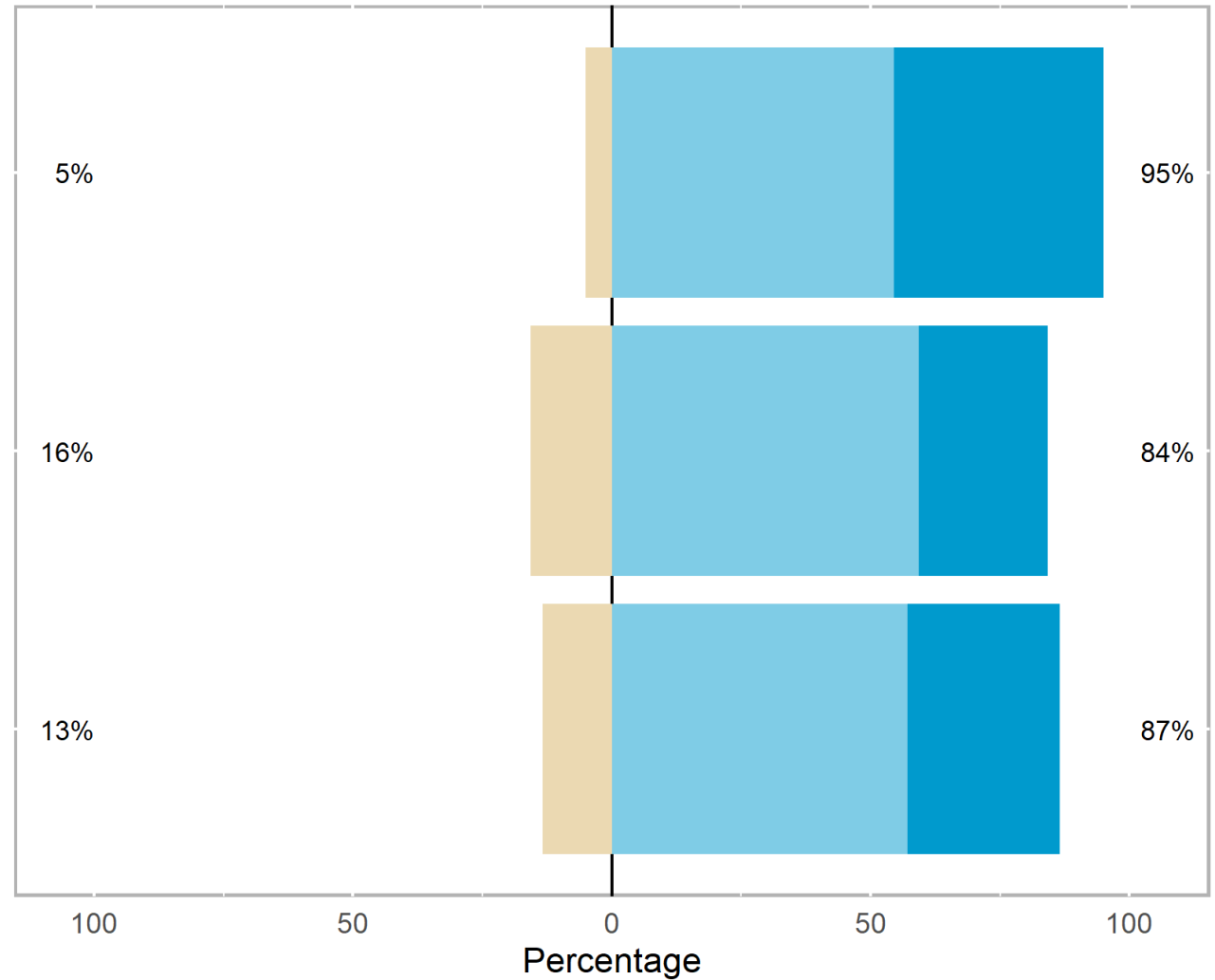
**Response**    Strongly Disagree    Disagree    Agree    Strongly Agree

*Overall response rate for each question about 37%

# What do Students Think of Complex Instruction?

- **We switch it up and I kind of like that** …. It doesn't feel like they're strangers. Every group that we've been with, we all have each other's contact information and … **we don't feel embarrassed asking questions**. This is even from the beginning.

- …So it's definitely **given me a sense of belonging** where I have the numbers I can contact half the people in the class

- I can turn to ask a question to my group member and then four weeks from now when they're no longer my group member they'll still be able to help me with a question… **I can go to anyone** and if they're struggling we will struggle together and **we'll figure it out**.

47
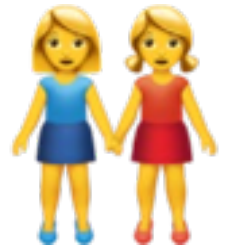
# Complex Instruction:

# Beyond Intro Stat

- CSUMB offers a statistics minor and major, and is just starting a data science minor
- I now use complex instruction in **all of my classes**
  - Probability and Statistics
  - Survey Sampling and Analysis
  - Statistical Computing
  - Generalized Linear Models
- **My classes came to life!**
- **No major change to the Complex Instruction Framework**
  - Roles are more flexible since students are naturally more engaged in upper-division courses
  - Even in electives, there are status issues to address

# Results

Did this work??

*I'm focusing on Fall 2018 – Spring 2020. Excluding the 2020-21 school year due to drastically different learning environment.

# Intro Stat Pass Rates

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

- What actually happened:

### Intro Stat Pass Rates
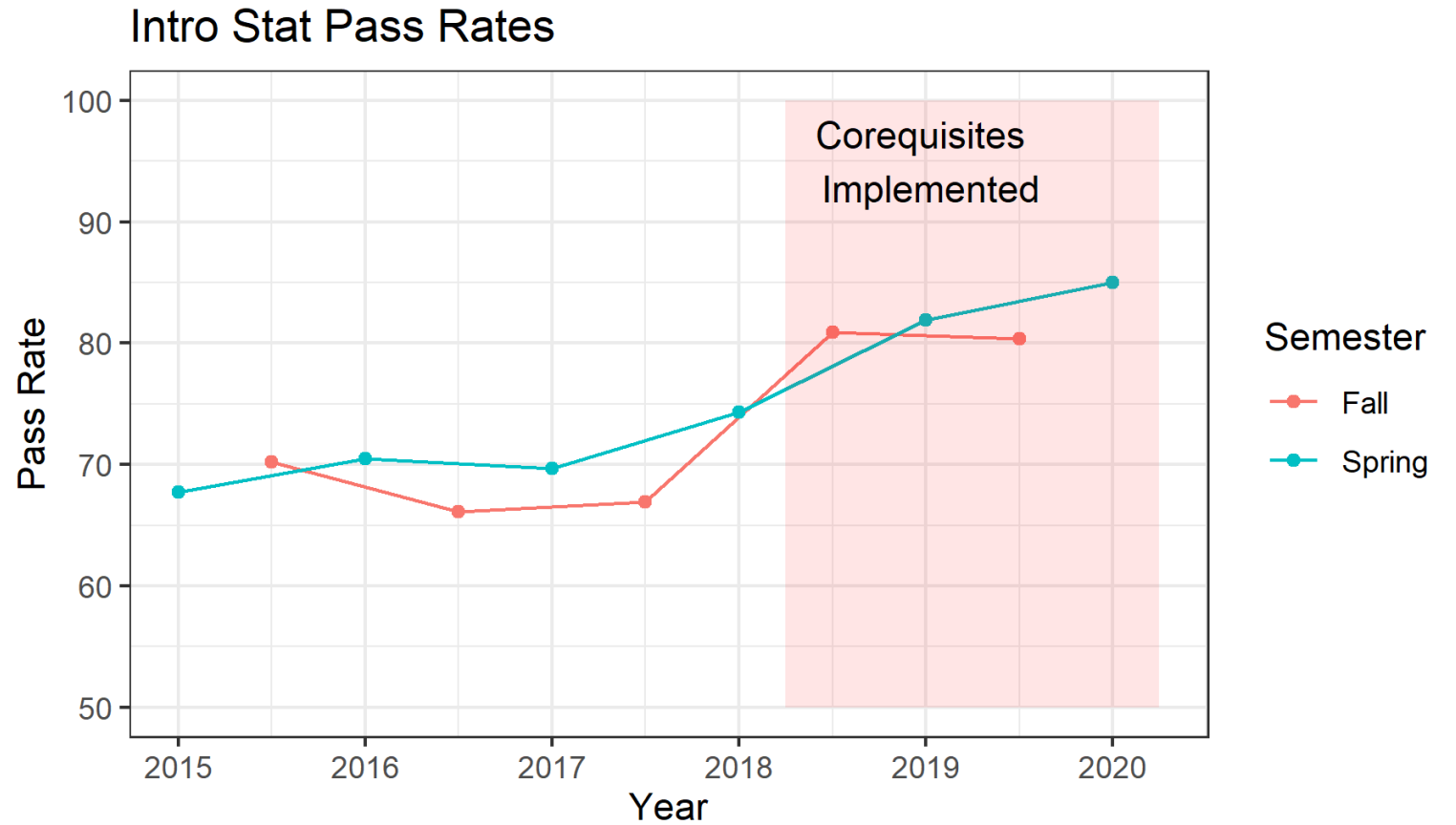


- Overall pass rates went **up**!!!

*Note: Spring 2020 was the first COVID semester

## 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

*COVID Semester!

## 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
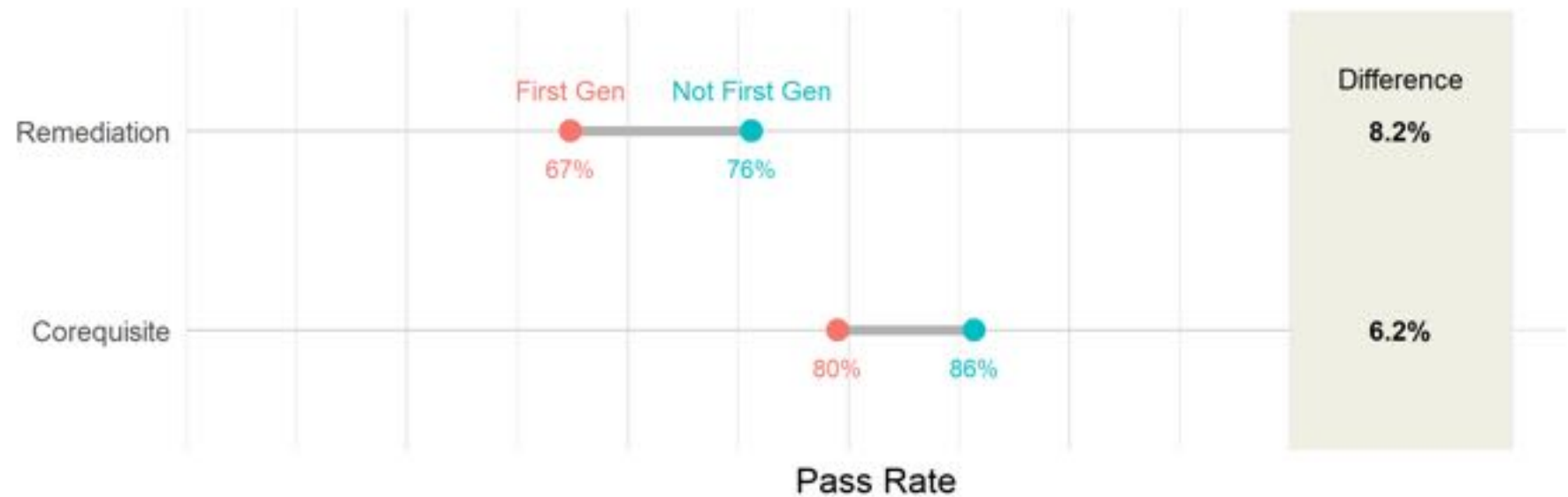
# Intro Stat Pass Rates

## 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 Complex Instruction and other course changes
  - "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*

|  | First Gen | Not First Gen | Difference |
|---|---|---|---|
| Remediation | 67% | 76% | 8.2% |
| Corequisite | 80% | 86% | 6.2% |

Pass Rate

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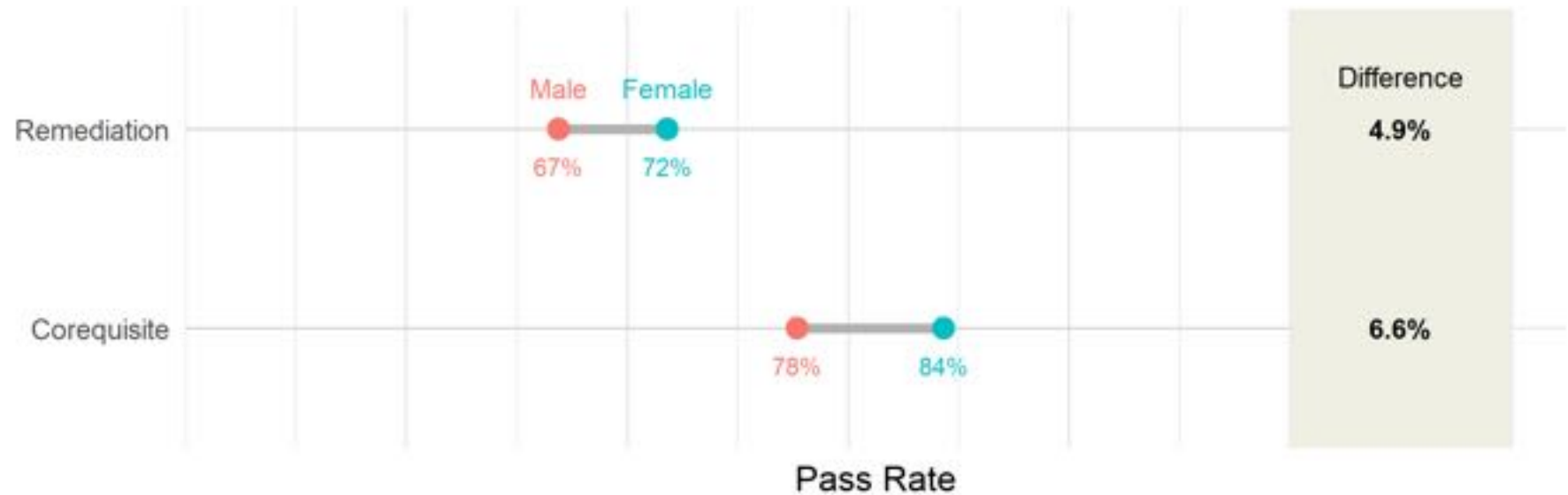Sample Sizes vary from around n=400 to n=800

*Thanks for the nice graph tutorial!

# Pell Eligibility
Equity Gaps

## Pell Eligible Student Pass Rate Equity Gaps in Intro Stat

*Comparing Remediation and Corequisite Models*

|  | Pell Eligible | Not Pell Eligible | Difference |
|---|---|---|---|
| Remediation | 67% | 75% | 7.8% |
| Corequisite | 79% | 86% | 7.2% |

Pass Rate

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*

| | Male | Female | Difference |
|---|---|---|---|
| Remediation | 67% | 72% | 4.9% |
| Corequisite | 78% | 84% | 6.6% |

Pass Rate

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 and complex instruction.
  - 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

# Side Note...

- **Attitudes Matter in Statistics!**
- [New NSF grant](#) with Stat Ed colleagues
  - Developing Validated Instruments to Measure Student/Faculty Attitudes in Undergraduate Statistics and Data Science Education
- Check out these 2 USCOTS posters for more info:
  - We-09: Students' Motivational Attitudes about Statistics: Results from the S-SOMAS Pilot
  - Th-13: SOMAS/SD: Measuring the Learning Environment, the Instructor, and the Student

# 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 😬
- Full buy-in to complex instruction is **a lot of work**
- Implementing roles can be challenging. Utilize them when the task is complex enough.

# 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.

- Go talk to your **math colleagues** about this!

- In **all** your classes, adopt **classroom structures** that support students at all levels of understanding and confidence

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

# Resources for Complex Instruction
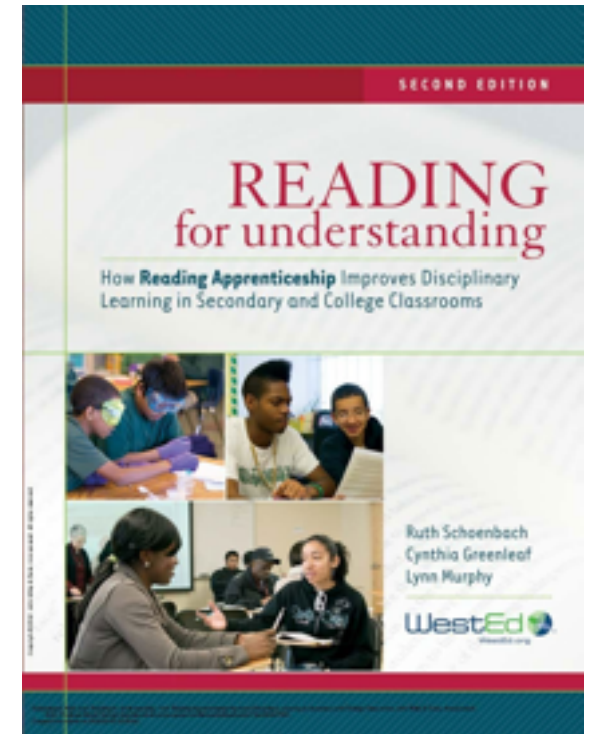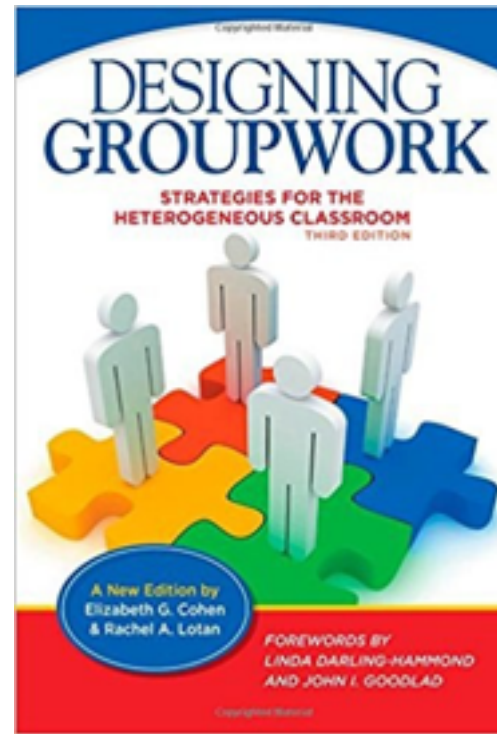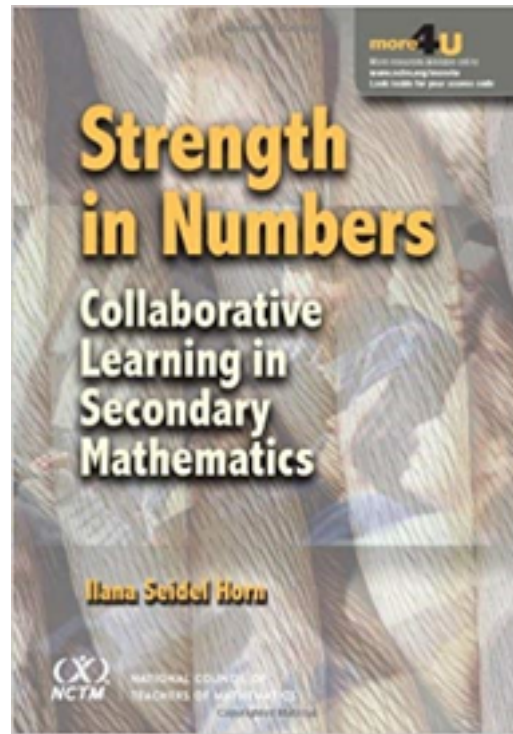
Also check out Peer Led Team Learning

# Thank You!

**Alana Unfried**

aunfried@csumb.edu

# Extras

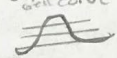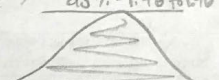# Getting Student Buy-In…

# The First Day!

- Day 1 of class is devoted to **Setting the Stage***

- Students are randomized to groups right away

- I lead them through 5 question prompts, and each group shares with the class at least once

- Questions include:
  - What is the value of making mistakes in the learning process?
  - How do we create a safe environment where risk taking is encouraged and productive failure is valued?

- We end our discussion with setting the **class norms**

## Setting the Stage

- For each of the questions that follow, I will ask you to:
  ○ Think about a possible answer on your own.
  ○ Discuss your answers with the rest of your group.
  ○ Share a summary of your group's discussion.

*https://danaernst.com/setting-the-stage/

## How Do I Have Time for All This Groupwork?

- We save time by implementing **Reading Apprenticeship**
- **Daily** reading assignments in preparation for next class
- Reading Logs checked at the beginning of class
- I never lecture on **everything** they read – why read if I am going to review it all anyways? My goal is to "lecture" no more than 20-30 minutes in one class period.
- Students are required to list one remaining question they have

# Assessment in Intro Stat

- **Grades**
  - (10%) Reading Assignments
  - (10%) Classroom Participation
  - (15%) Online Homework
  - (15%) Group Project
  - (30%) Three Midterm Exams
  - (20%) Final Exam

- **Formative Assessment**
  - ABCD Cards to check understanding
  - Practice Tests
  - Classroom Groupwork
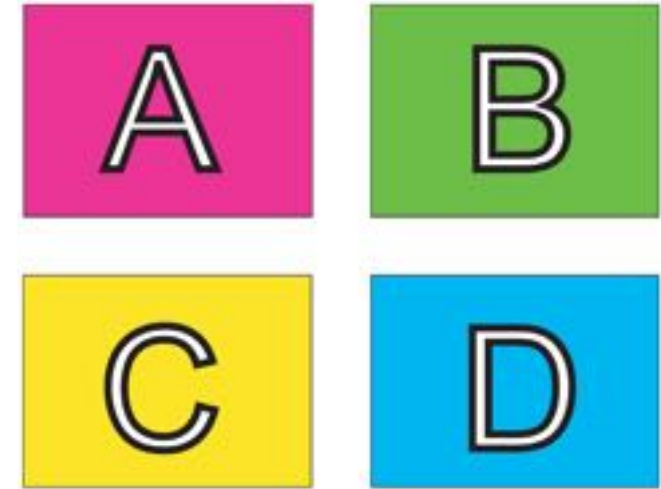
# Corequisite Grading Structure

- 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)

# 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

# Student Experiences Survey

- Data collected at end of semester Fall 2018 through Spring 2020

- Google Form survey to capture student responses on their affect and experience in their GE course administered at the end of the semester.

- 62% of students consented to participate in the research study (n=688 out of 1,104)

- Response rates ranged from 64% to 72% per question

Comparing pass rate (%) of GE courses in S19 between those who took a support course and those who did not take a support course

**All students in GE (N = 601)**

| Course | Took a support course | | Did not take a support course | | Overall | |
|---|---|---|---|---|---|---|
| | Pass % | N | Pass % | N | Pass % | N |
| MATH100 | 62.5 | 16 | 94.6 | 56 | 87.5 | 72 |
| MATH115 | 76.0 | 25 | 77.3 | 88 | 77.0 | 113 |
| MATH130 | 62.5 | 16 | 58.6 | 133 | 59.1 | 149 |
| STAT100 | 87.1 | 62 | 80.5 | 215 | 81.9 | 277 |

**Those who took DSP and were identified as "support needed" by DSP (N = 90)**

| Course | Took a support course | | Did not take a support course | | Overall | |
|---|---|---|---|---|---|---|
| | Pass % | N | Pass % | N | Pass % | N |
| MATH100 | 66.7 | 6 | 100.0 | 11 | 88.2 | 17 |
| MATH115 | 88.9 | 9 | 37.5 | 8 | 64.7 | 17 |
| MATH130 | 66.7 | 3 | 58.3 | 12 | 60.0 | 15 |
| STAT100 | 92.3 | 13 | 78.6 | 28 | 82.9 | 41 |

**Those who took DSP and were identified as "support not needed" by DSP (N = 90)**

| Course | Took a support course | | Did not take a support course | | Overall | |
|---|---|---|---|---|---|---|
| | Pass % | N | Pass % | N | Pass % | N |
| MATH100 | NA | 0 | 90.0 | 10 | 90.0 | 10 |
| MATH115 | 75.0 | 4 | 80.0 | 10 | 78.6 | 14 |
| MATH130 | 100.0 | 2 | 62.5 | 24 | 65.4 | 26 |
| STAT100 | 85.7 | 7 | 93.9 | 33 | 92.5 | 40 |

**Those who did not take DSP or did not complete DSP (N = 431)**

| Course | Took a support course | | Did not take a support course | | Overall | |
|---|---|---|---|---|---|---|
| | Pass % | N | Pass % | N | Pass % | N |
| MATH100 | 60.0 | 10 | 94.3 | 35 | 86.7 | 45 |
| MATH115 | 66.7 | 12 | 81.4 | 70 | 79.3 | 82 |
| MATH130 | 54.5 | 11 | 57.7 | 97 | 57.4 | 108 |
| STAT100 | 85.7 | 42 | 77.9 | 154 | 79.6 | 196 |

# Comparative Pass Rates

| | Quant. Literacy | Finite Math | Pre-Calculus | Intro Stat. | Total |
|---|---|---|---|---|---|
| Completed remediation (F16) | 88% | 42% | 40% | 48% | 135 / 266 51% |
| Took support class (F18) | 94% | 67% | 71% | 85% | 111 / 138 80% |