Exploring the Effect of Supplemental Instruction on Equity Gaps: Student

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Original Source Data (via CSU Chico Instituional Research)

- Course Detail.csv
  - n = 43,803
  - Row contains record for course sections from Fall 2012 to Winter 2022
- Student Profile Metric.csv
  - n = 49,107
  - Row contains one record per student matriculation for students enrolled from Fall 2012 to Spring 2022
- Student Program.csv
  - n = 343,781
  - Row contains records for each semester of each student's attendance who were enrolled from Fall 2012 to Winter 2022

Original Source Datasets (acquired via CSU Cico Instituional Research)

- SLC Appointment.csv
  - n = 78,229
  - Row contains record for each day that a student went to an SI session, and how many they went to in that day (Fall 2015 - Spring 2022)
- Student Grade.xlsx
  - n = 864,471
  - Row contains final grade data earned for each course for each student from Fall 2016 to Winter 2022

Data Preparation

Student Level Analysis (n = 19,565)

- Only student records dated 2016 or later
- Only first-time freshmen
- Best attempt at isolating most recent student program record
- Approximately 35% of students in the programs dataset are not present in the profiles dataset. Therefore, these records have missing data for HS/Transfer GPA, one-year retention, and matriculation/graduation terms
- Records with missing data for the following attributes were dropped:
  - High School GPA
  - Attended Orientation Flag
  - STEM Major Flag
  - Full Time / Part Time Code
  - Academic Program

Data Preparation

Course Level Analysis (n = 5,637)

- Includes class size, average high school GPA, % first-gen in the class, % URM in the class, DWF rate, SI component flag, term year
  - These were calculated using the grades data provided by IR
  - Students with missing records for high school GPA were not included in the calculation
  - Students with missing records for URM and first-gen status were considered as not a member of these groups
- Course records from 2016-2019
- Course sections with less than 10 records of an SI visit during the semester were considered as sections without an SI-component
- Courses represented have a number less than 300 and are not a special number (x89, x99, etc.)
- To remove high calculated DWF outliers, class size $>=$ 20

Data Preparation

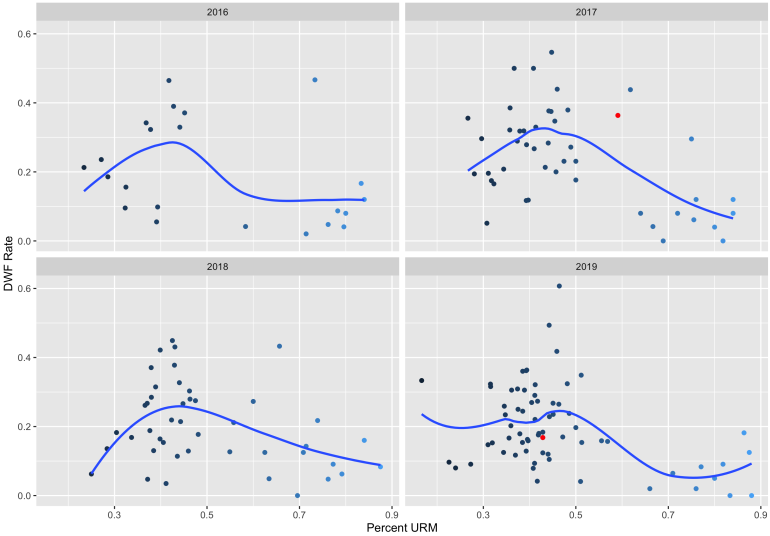
Coarsened Exact Matching Analysis (n = 19,565)

- Student profiles, programs, and grades with course level information for courses with SI
- Only student records dated 2016 to 2019 who DID NOT DROP
- Best attempt at isolating most recent student program record
- Approximately 35% of students in the programs dataset are not present in the profiles dataset. Therefore, these records have missing data for HS/Transfer GPA, one-year retention, and matriculation/graduation terms
- Records with missing data for the following attributes were dropped:
  - High School GPA
  - Attended Orientation Flag
  - STEM Major Flag
  - Full Time / Part Time Code
  - Academic Program

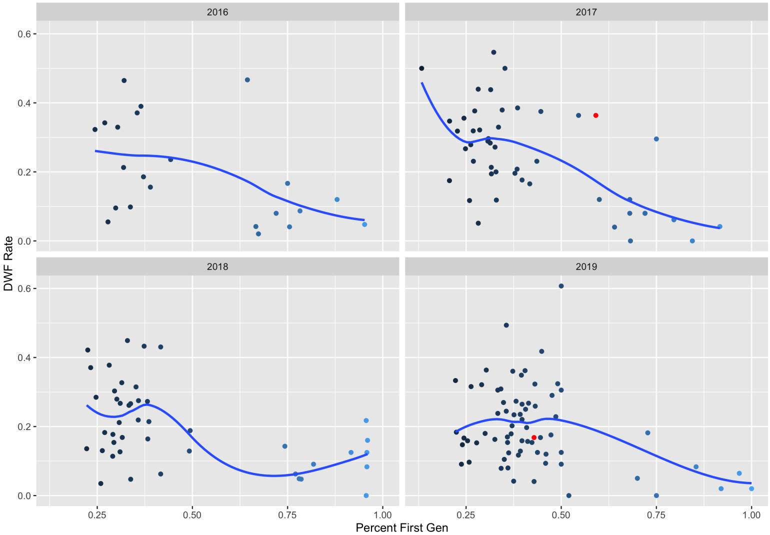
Course Level Details

- Variables: avg HS GPA, First Gen, URM, class size, DWF rate, class average, SI component, term year
- Courses from term years 2016-2019
- URM and First Generation percentages
- Lower Division courses
- Courses with class size 20+

URM and DWF Rate



First Generation and DWF Rate



Course Level Modelling

Table 1: Results Multilinear Regression

	Dependent variable:
	dwf.rate
SI.Component.Flag1	0.008 (0.005)
URM	-0.010^{**} (0.005)
First.Gen.Perc	0.009 (0.006)
class.size	-0.0001^{**} (0.00002)
class.average	-0.174^{***} (0.001)
Constant	0.626^{***} (0.004)
Adjusted R^2	0.741
F Statistic	$3{,}231.362^{***}$ (df = 5; 5631)
Note:	$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Course Level Modelling

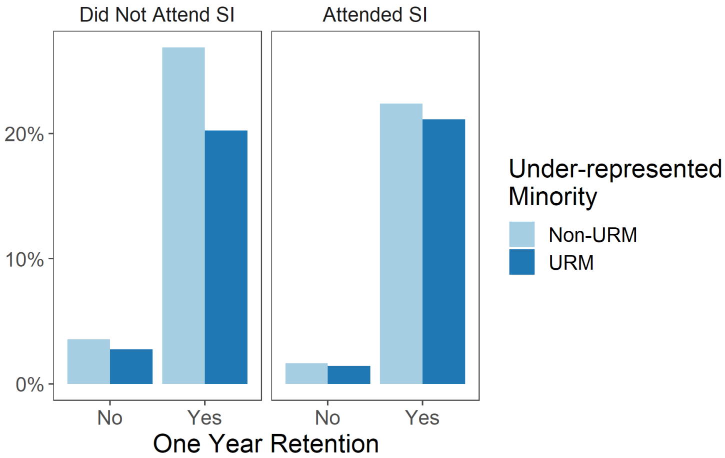
Table 2: Results Multilinear Regression With Interaction

	Dependent variable:
	dwf.rate
SI.Component.Flag1	0.041*** (0.014)
URM	−0.012** (0.005)
First.Gen.Perc	0.012** (0.006)
class.size	−0.0001*** (0.00002)
class.average	−0.174*** (0.001)
SI.Component.Flag1:URM	0.021 (0.044)
SI.Component.Flag1:First.Gen.Perc	−0.096*** (0.037)
Constant	0.626*** (0.004)
Adjusted R^2	0.742
F Statistic	2,314.955*** (df = 7; 5629)
Note:	*p<0.1; **p<0.05; ***p<0.01

Student Level Analysis

- Measuring student level equity gaps
  - Students who under represented minorities
  - Students who are first generation
- Measuring success
  - One-year retention

Student Level Analysis

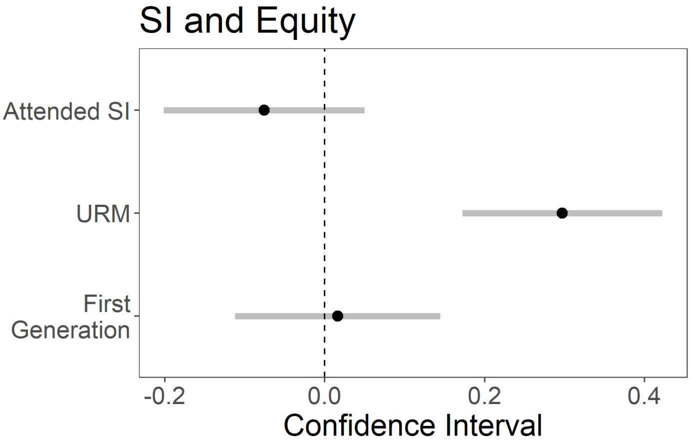


Student Level Analysis

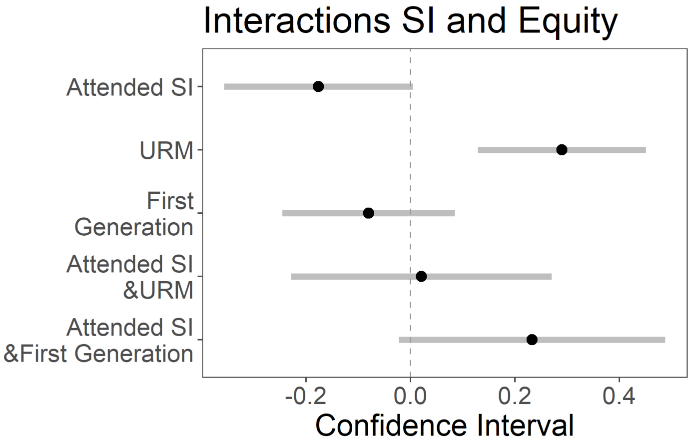
Student Level Analysis: Modeling

- Logistic regression
- Explanatory variables:
  - Student characteristics: URM, First Generation, Gender, Stem Major, number of units taken in the semester, number of units passed in the semester, Cohort term year, SI attendance
  - Course characteristics: Academic level, Course fee existence, GE class

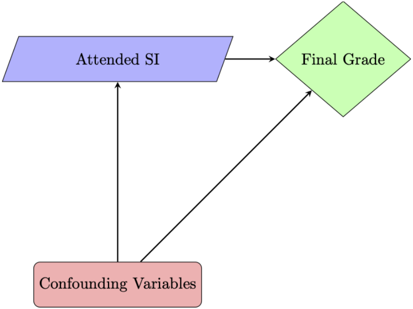
Student Results



Student Results: Interactions



Causal Inference

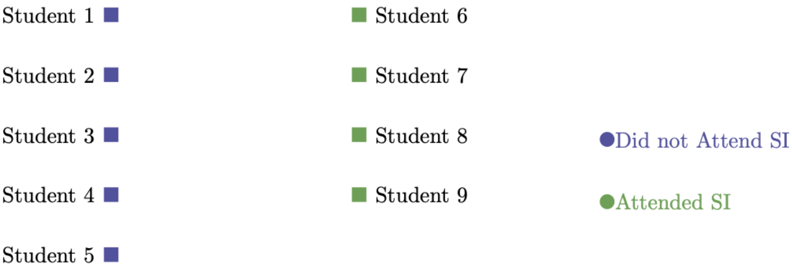
- 

- We want to measure the impact SI has on student performance.
- We need to control for these confounding variables!
- We can accomplish this by matching students with similar characteristics.

How do we match?

- We can't match exactly!
- We coarsen our covariates (think binning).
- We can now match exactly on our coarsened data.
- Lastly, throw out any unmatched observations

Controlling for Confounding with Coarsened Exact Matching



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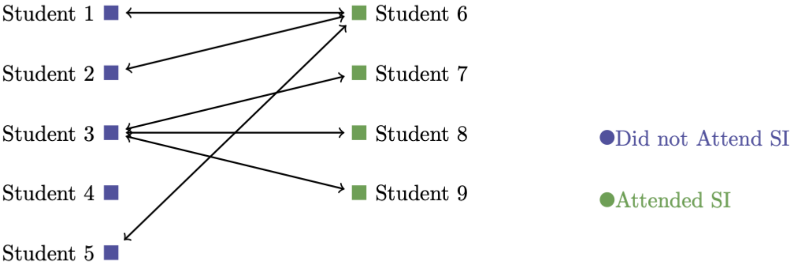
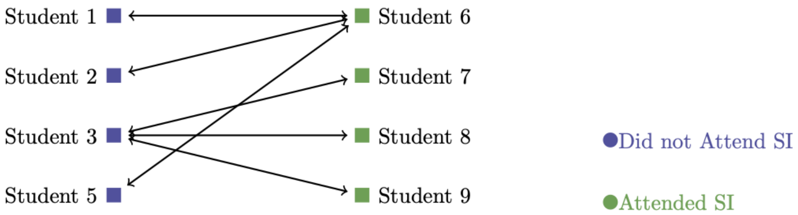


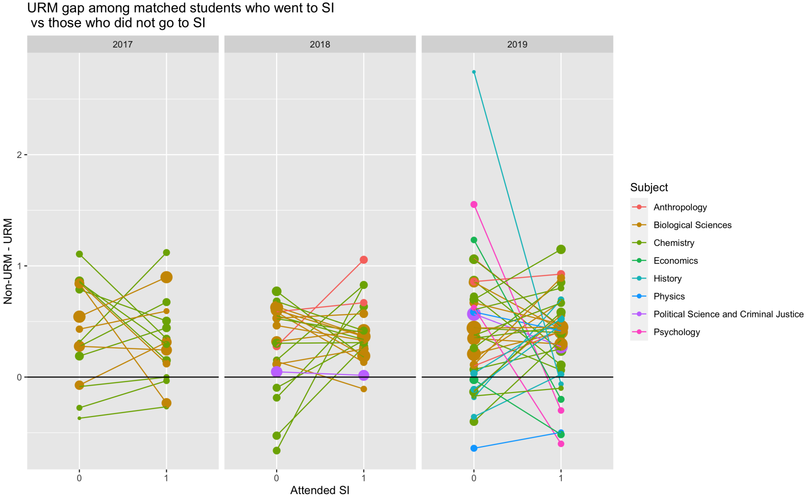
Controlling for Confounding with Coarsened Exact Matching



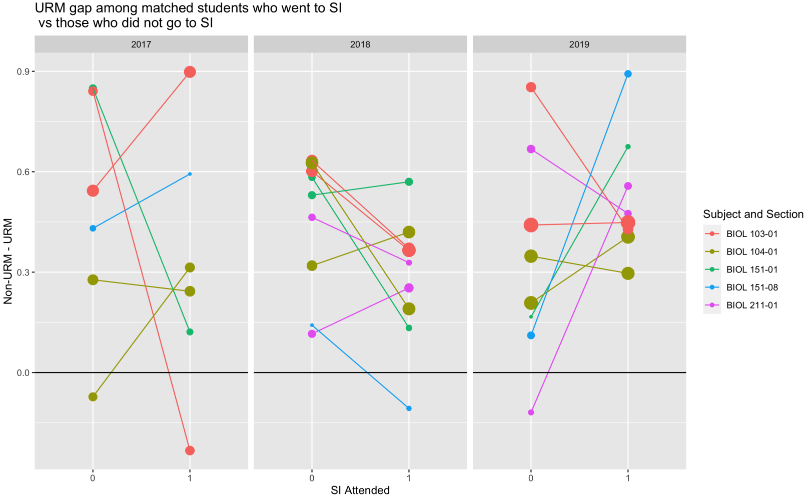
Covariates for Matching

- Notion: Good students go to SI, so the benefit is inflated.
  - High School GPA: Helps address the notion SI is only seems benefical.
  - Student Orientation Flag:
  - Major Stem Flag
- Demographics
  - Random Course ID
  - Academic Level
  - First Generation Flag
- Equity Gaps
  - URM/NonURM Flag
  - Gender Code

Visualizing the Equity Gap



Visualizing the Equity Gap



Effect of SI in General

- After creating our matching, we fit a linear model to estimate the effect SI has on a students final grade.
- We find, after controlling for our confounding variables, SI improves students final grade by half of a letter grade.
- This doesn't address the question of whether or not SI reduces equity gaps.

Limitations

- We have no data on student living situations.
- The Oroville dam flooding and Camp fire are not being accounted for.
- We are treating equity gaps separtely.

Next Steps

- Meet with an expert in Casual Inference.
- Can we extended Causal Inference Techniques to account for equity gaps?
- Can we put dollar amount on the benefit of SI by extending the results of the Casual Inference analysis.