Examining the Effect of a Pedagogical Change in a High Failure Rate College Science Course in the Face of a Shifting Demographic Student Body

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Disclaimer & for more information

This work was conducted under a Sustaining Success in Course Redesign Project funded by the California State University (CSU) Chancellors Office for 2016-17.

The results and views expressed from this work do not represent official views from the CSU System, CSU, Chico nor any of the Colleges and Departments within.

The full portfolio for this work can be found at `https://norcalbiostat.github.io/chem_ss/`

Purpose of Study

- Earning a repeatable grade (D,F,W) is associated with an increased time to graduation.
- CA Legislature has been pushing hard to increase 4 year graduation rates.
- CSU Graduation Initiative 2025 - dramatically increase 4 year grad rates & **eliminate at-risk student achievement gaps**.
- The CSU Chancellors office awarded grants to faculty willing to redesign their courses to include technology and active learning techniques to lower their DWF rate.
- 1st semester Chemistry has a nationwide DWF rate of ∼30%.
- Fall 15 (F15) an instructor at CSUC redesigned their large lecture class to include technology (CRT).

Mixed Results

While there was an immediate improvement seen, it was muted in Spring.

	F14	F15	S16
GPA	1.53	1.78	1.65
DFW rate	0.45	0.36	0.39

Ancedotally, this instructor noticed that there were a higher number of "at risk" students in the spring cohort compared to fall.

Furthermore, it is "common knowledge" that the spring cohort is "different" than the traditional fall cohort.

Fall vs. Spring?

- This lead the instructor to ask questions about the difference in demographic makeup between semesters
- Analysis was limited to bivariate comparisons of DWF rates between specific "at risk" groups
  - Males vs Females
  - Underrepresented minorities (URM) vs non-URM
  - First generation students vs those with college graduate parents

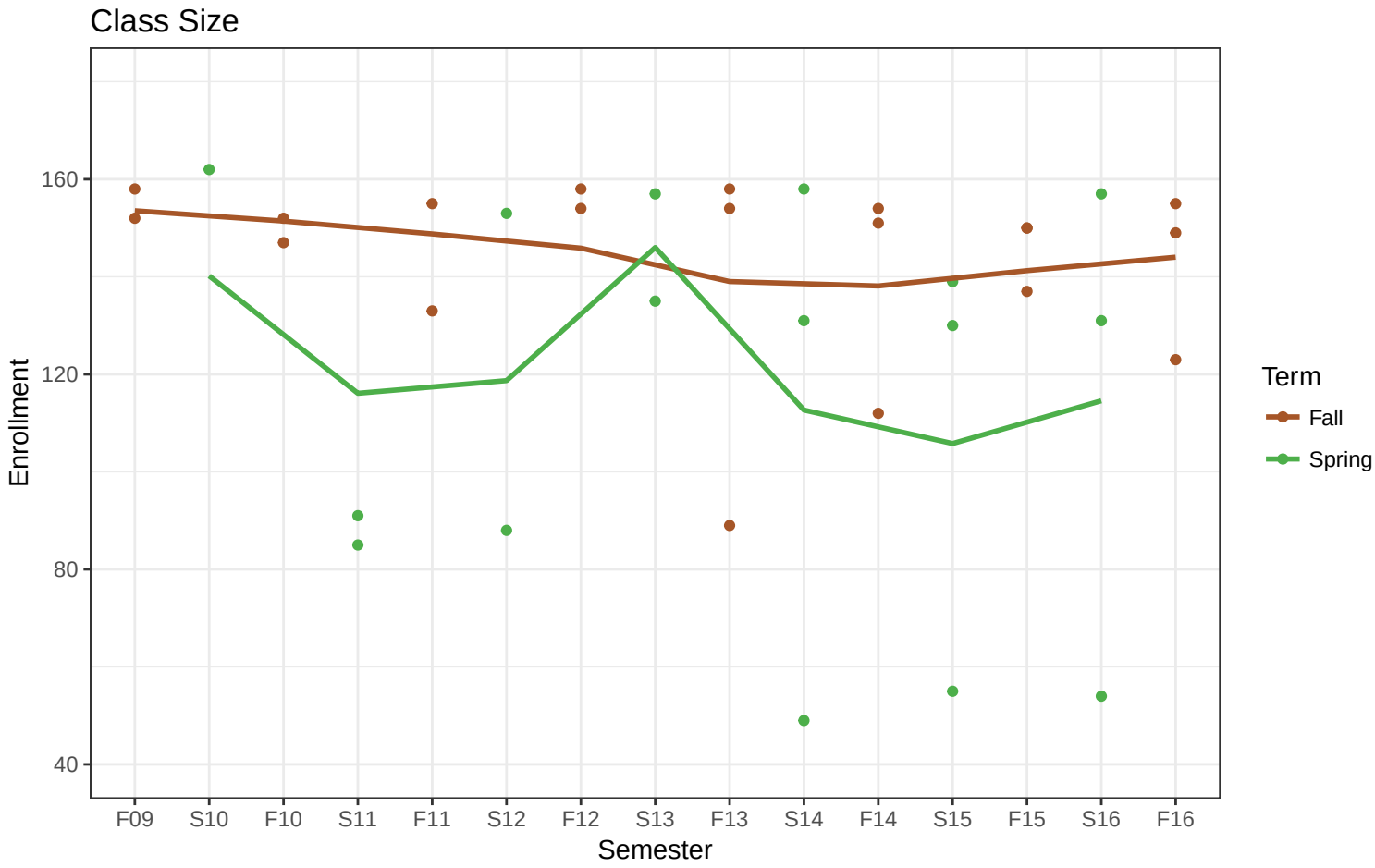
The questions that subsequently arose rapidly outpaced this instructor's statistical analysis capabilities.

Interdisciplinary collaboration

- Move past bivariate comparisons - $f(success|otherfactors)$
- Examine distributional changes, not just compare point estimates.
- What is the demographic profile of a Chemistry class, and how has that changed over the past 5 years?
- How does the profile of a Chemistry class compare to the overall campus demographic makeup?
- What was the impact of a redesign with technology (CRT) on student success after controlling for other factors such as academic preparation?

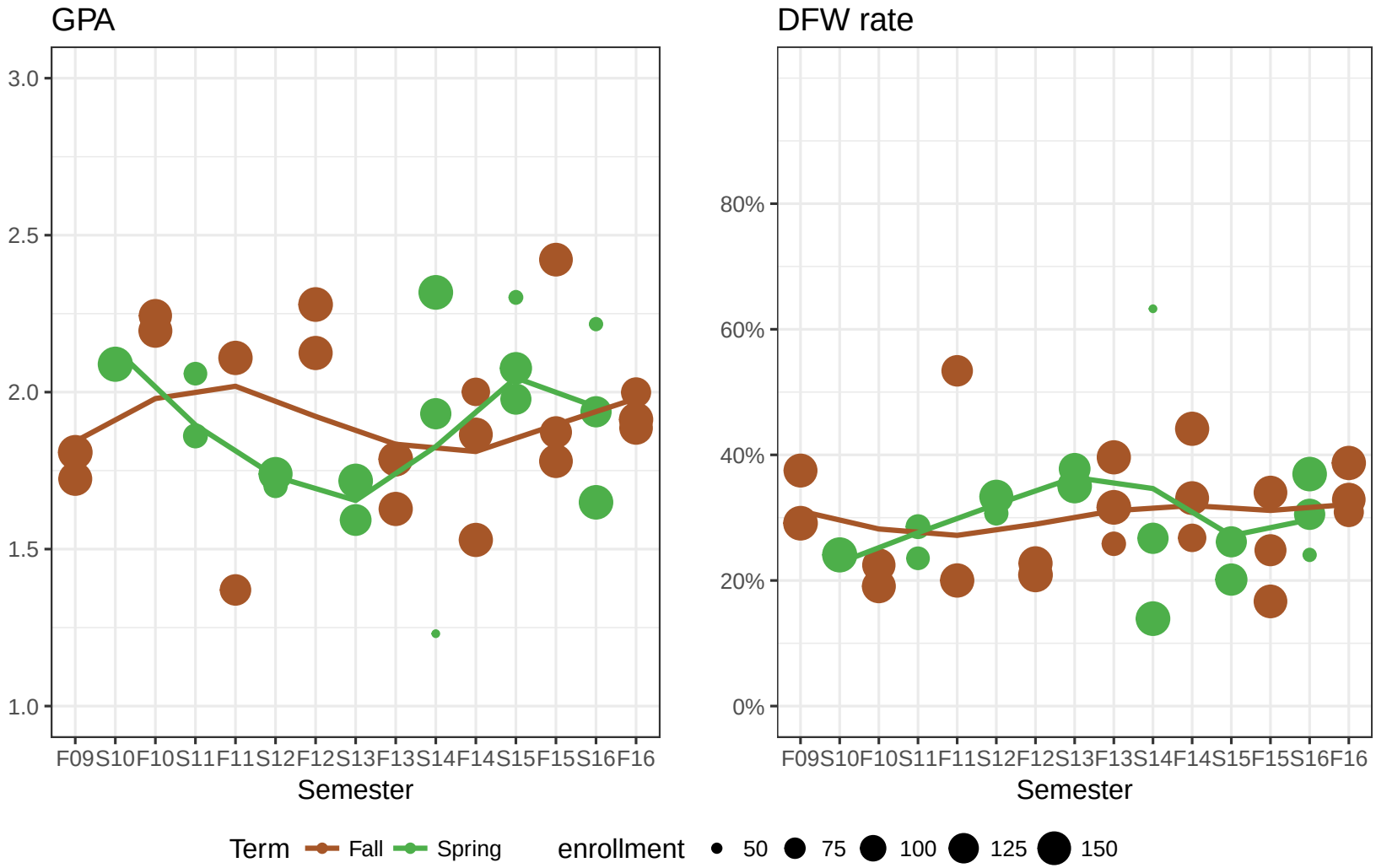
Scope - Size of impact

- Large lectures: 160 enrollment cap.

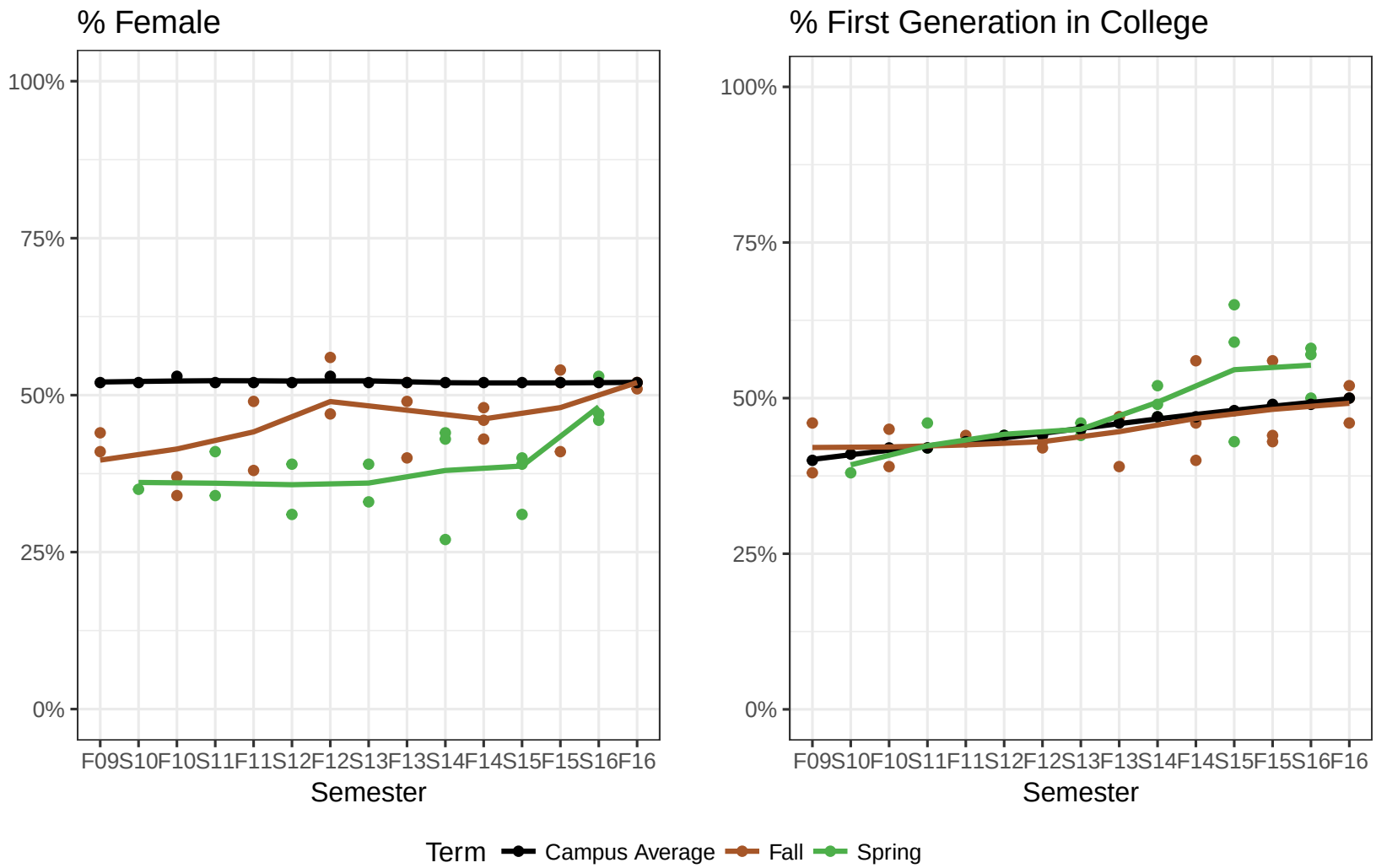


Class level Academic Performance

- GPA hovering about 1.8, DWF rate from 25-40%

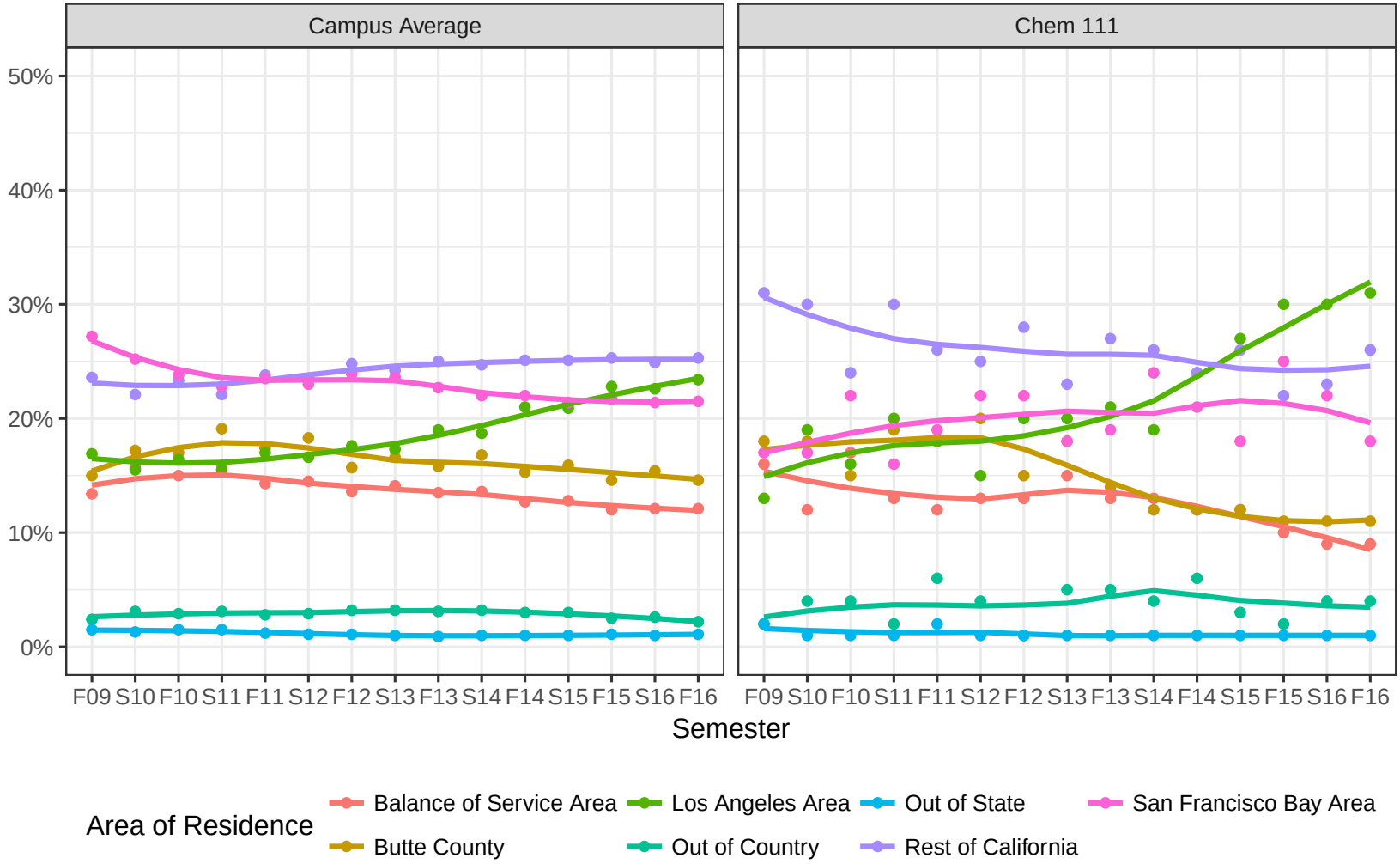


Demographics: Gender & First Generation Status



Demographics: Residential Area

- % SoCal going up, % Norcal going down. Exacerbated in Chemistry.

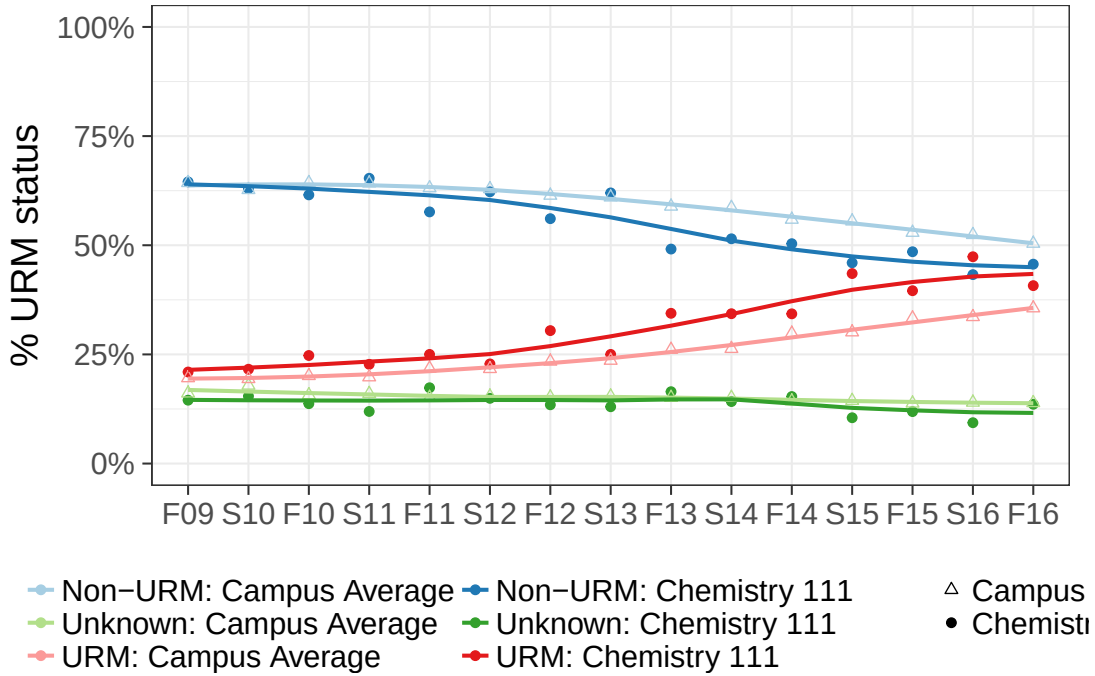


Demographics: Underrepresented Minority

Trends in General Chemistry about 2 years ahead of the general campus population.

Campus Definitions

- URM: American Indian/Alaskan Native, Black, Hispanic/Latino
- Non-URM: Asian, Native Hawaiian and Other Pacific Islander, White
- Unknown: Multi Racial, Unknown

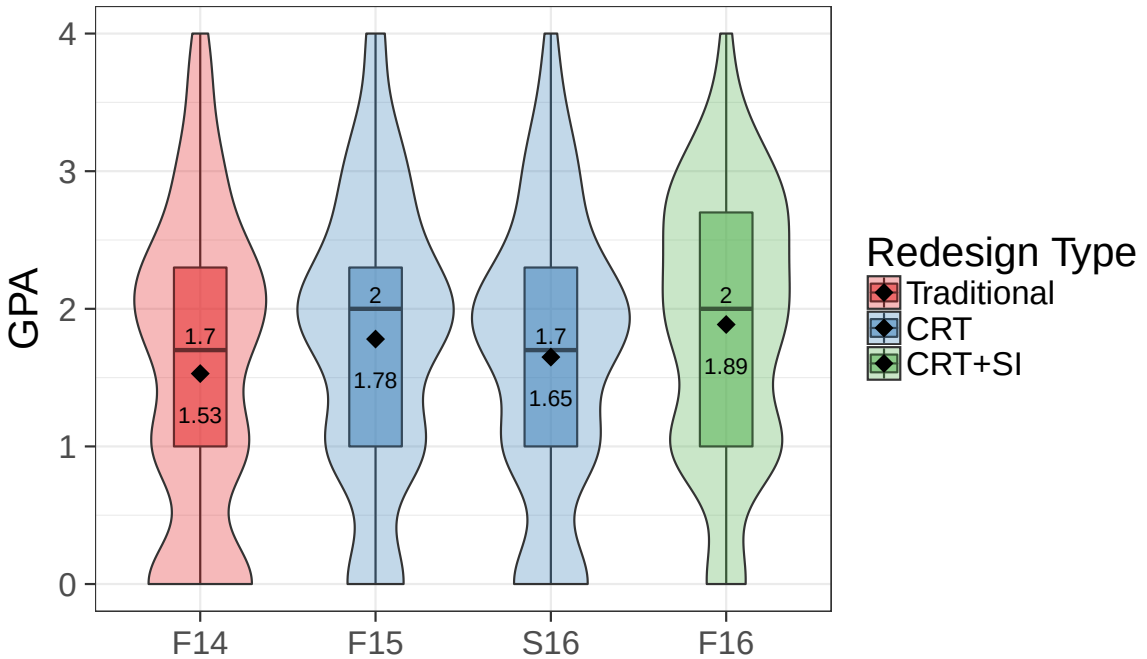


Impact

- CSUC reached HSI status recently (25% H/L), Gen Chem hit that mark semesters earlier.
- Majority of new H/L students has been extensively from SoCal (500 mi away), from families that have little or no history of a college education, to a location and culture that is quite possibly very different than they are familiar with.
- Any impostor syndrome or stereotype threat that they experience, any encouragement to "just come home" is likely to be evidenced to a greater degree in Gen Chem.
- Being aware of the new socioeconomic and psychological experiences of our rapidly changing student body is the only way we as faculty can hope to adapt our practices to address the unique challenges (or the new norms?) that accompany these new students.

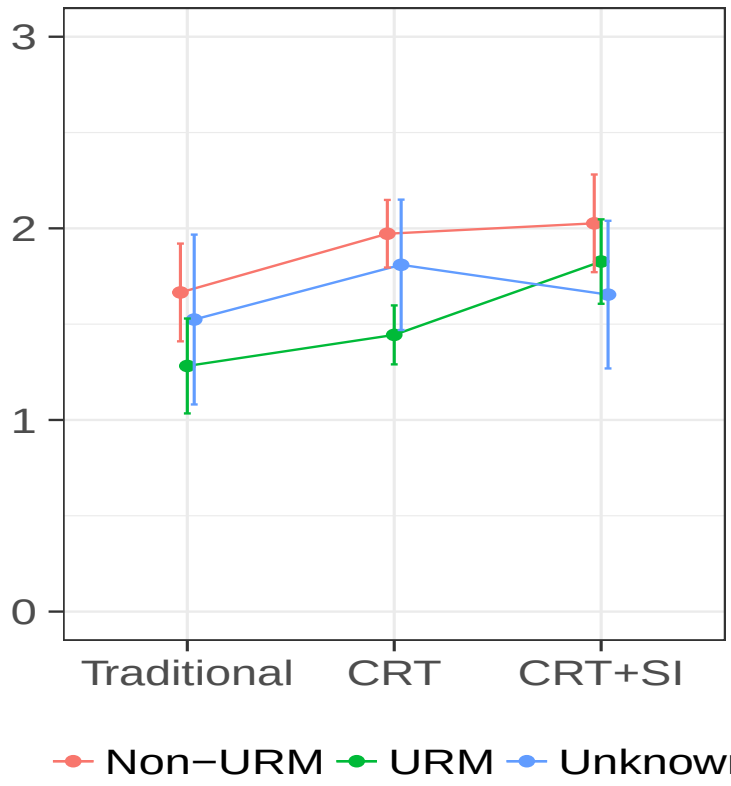
Analysis Sample

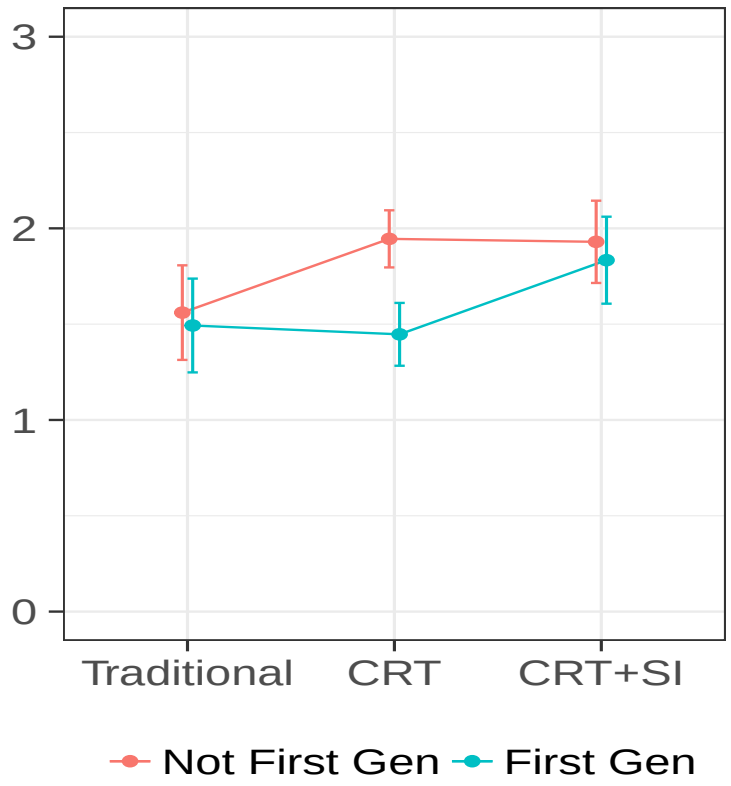
- By S17, F16 data was available which added a "near peer" method of student support: Supplemental Instruction (SI)
- Analysis is on $n = 610$ students from a single instructor
- Mixed results reflected in point estimates only
- Analyzed GPA (linear) and DWF (logistic) outcomes separately



Impact on at risk groups

- Mean (95 %CI) GPA by risk group across course type
- Differential impact of intervention on different groups.
- At-risk group not showing improvement without SI



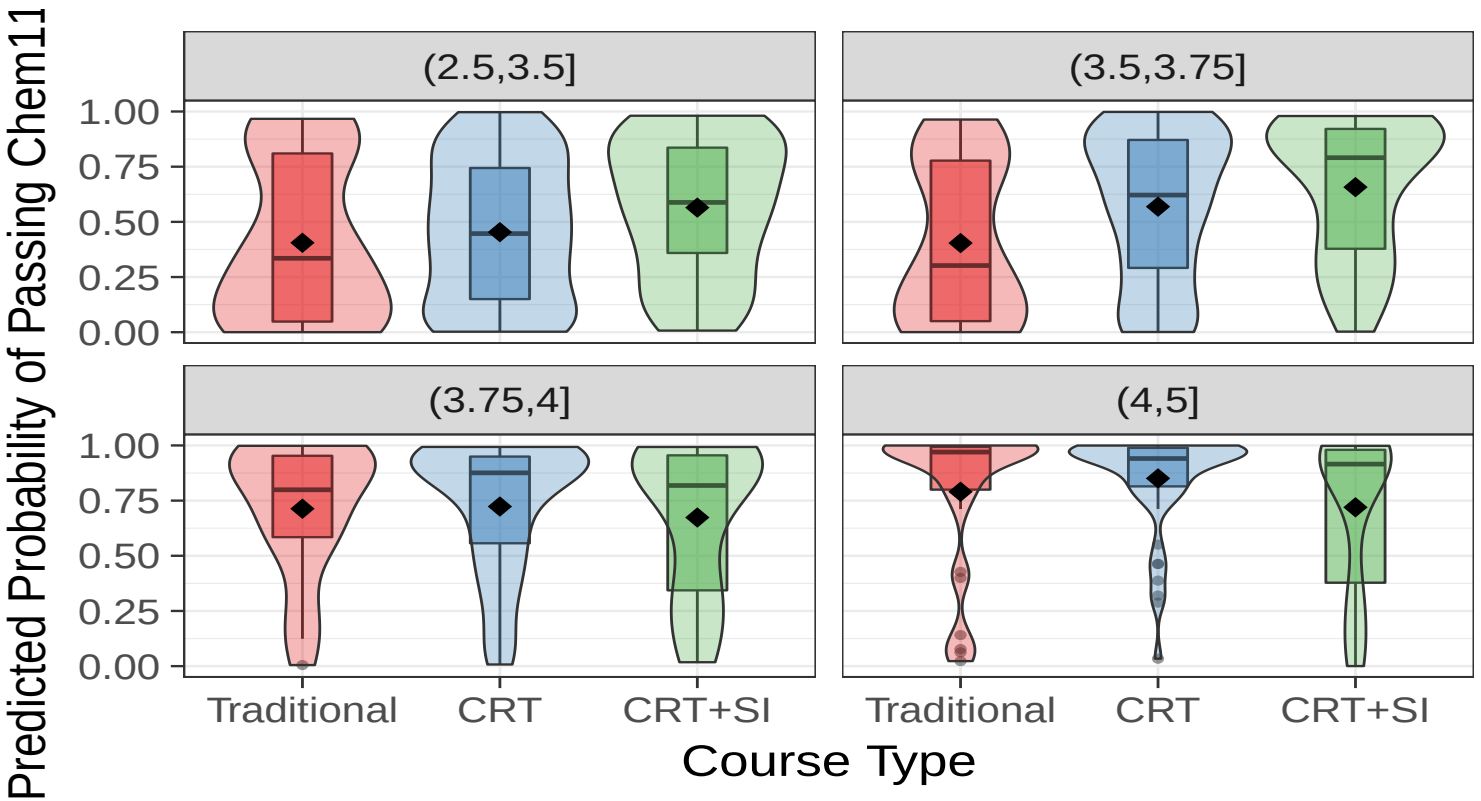


Model Building

- Separate Random Forest models were built to identify factors important in predicting GPA and a repeatable grade.
- Variables with high importance were used as a starting set
- Models were simplified using loose backward selection and interaction testing.
- Final models for GPA and DWF were very similar, but not identical.
  - Gender (M/F)
  - Age (knot at 22)
  - URM (URM/Non-URM/Unk)
  - First generation (Y/N)
  - Admissions index (knot at 3.8)
  - Academic level (Fr/So/Jr/Sr)
  - Term GPA
  - College of Major (NS/ECC/OTH)
  - Course Redesign type (Trad/CRT/CRT+SI)
  - College prep English and math units (<4/4-6/6-8/8+)
  - GE course completion status (English/Math/Critical Thinking)
  - Entry level English/Math proficiency
  - Interaction between admissions index and Course redesign type

Impact of CRT + SI on student success

- Only results for DWF are presented here (GI2025 priority)
- Highest impact for the lower HSEI groups.



Next analytical steps

- Build an analytical model that includes a model for self-selection into SI (and possibly the number of times a student goes to SI)
- Candidate approaches: propensity score matching, Bayesian hierarchical model with a ZINB model for SI attendance

How can we use these results to inform future process

- Immediate impact: Inform instructors about the characteristics of their classes.
- Near term impact: Provide evidence that interdisciplinary collaboration with a statistician and good quality data is necessary for deep understanding of the data.
- Longer term impact: Present results to the Graduation Initiative Team to help inform recommendations from the committee regarding both Student and Academic Affairs policy, resources and organization of near-peer student support services.

Questions or want to see more?

Thank you! Any questions?

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