# Investigating the Effectiveness of Supplemental Instruction on Student Performance and STEM Retention

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**with Mr. Eric Braun**

# Overview of Supplemental Instruction

- Specialized Tutors
  - Exemplary Performance
  - Nominated by Faculty, Director, or Peers

- Three Roles
  1. Model Student
  2. Session Facilitator
  3. Collaborator

# STEM Majors Supported by SI

- Environmental Science
- Computer Science
- Psychology
- Chemistry
- Biology
- Physics
- Mathematics
- Management Information Systems (not supported)

# Current Reality (2014-2015 Academic Year)

- 72 SI Leaders were employed in the 2014-2015 Academic Year
- 38 courses supported in 13 subject areas
- 124 individual sections supported
- 27% of targeted courses are supported with SI Leaders

| Number of Visits | Number of Students | Percent of Students |
|---|---|---|
| 0 | 1814 | 46.4% |
| 1 | 601 | 15.4% |
| 2—4 | 728 | 18.6% |
| 5—7 | 347 | 8.9% |
| 8+ | 417 | 10.7% |

# Questions

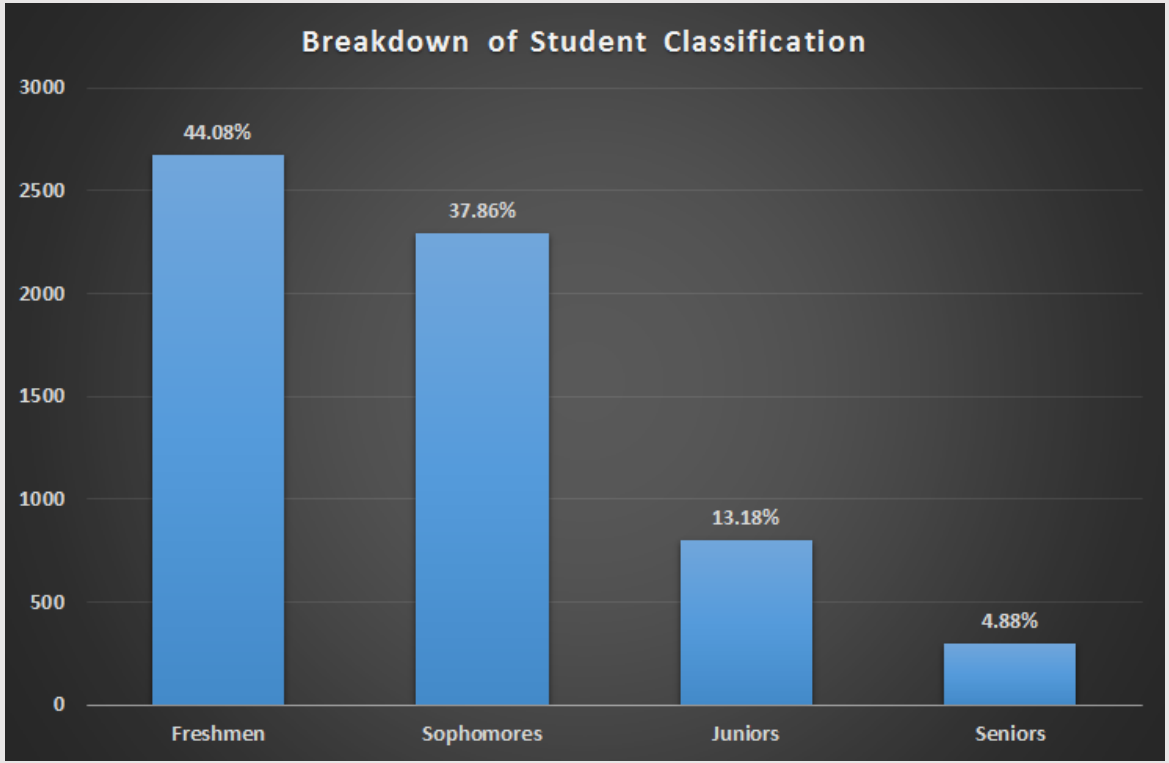
1. How does Supplemental Instruction affect student grades?

2. Does participation in Supplemental Instruction have an effect on retention of STEM majors?

# Data Processing

- Collected data from the Office of Institutional Research and Effectiveness, the Learning Center, and the United States Census Bureau
- Considered first-time full-time cohorts over the previous three years
- Imputed missing data using the **R** package Amelia to reduce dropped data bias

# Visualizations




**6064 total observations across 5 semesters**

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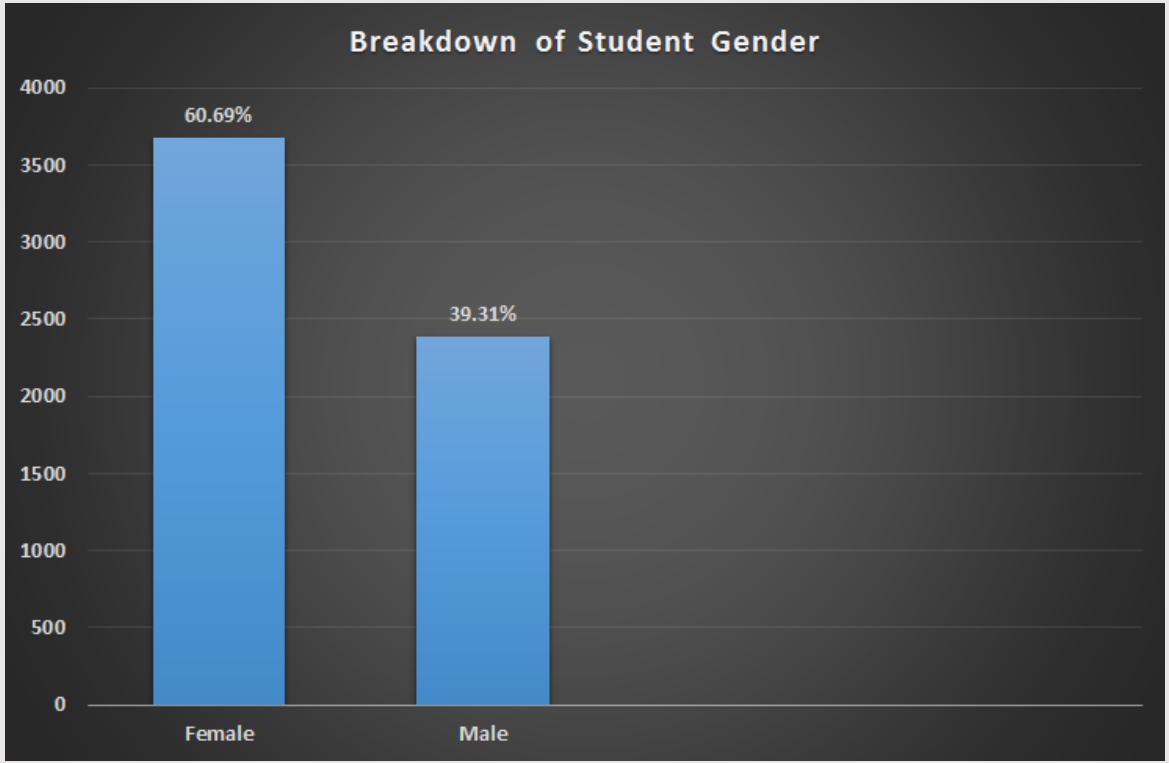


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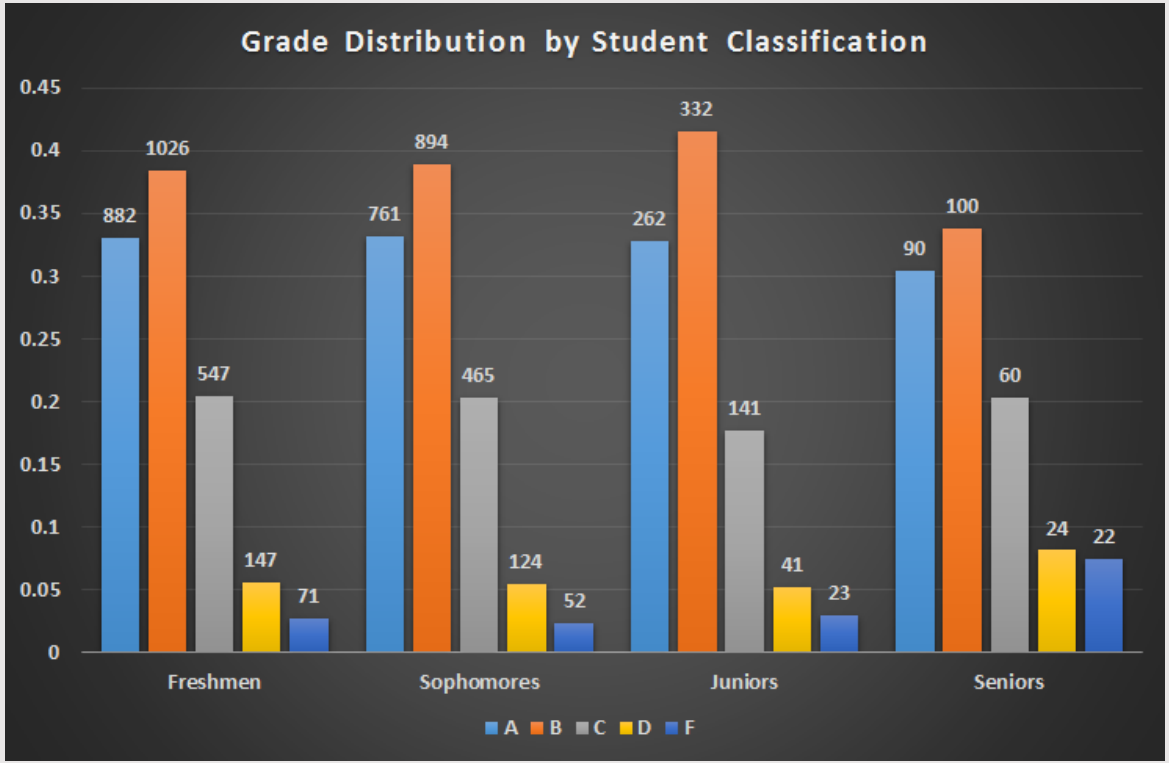


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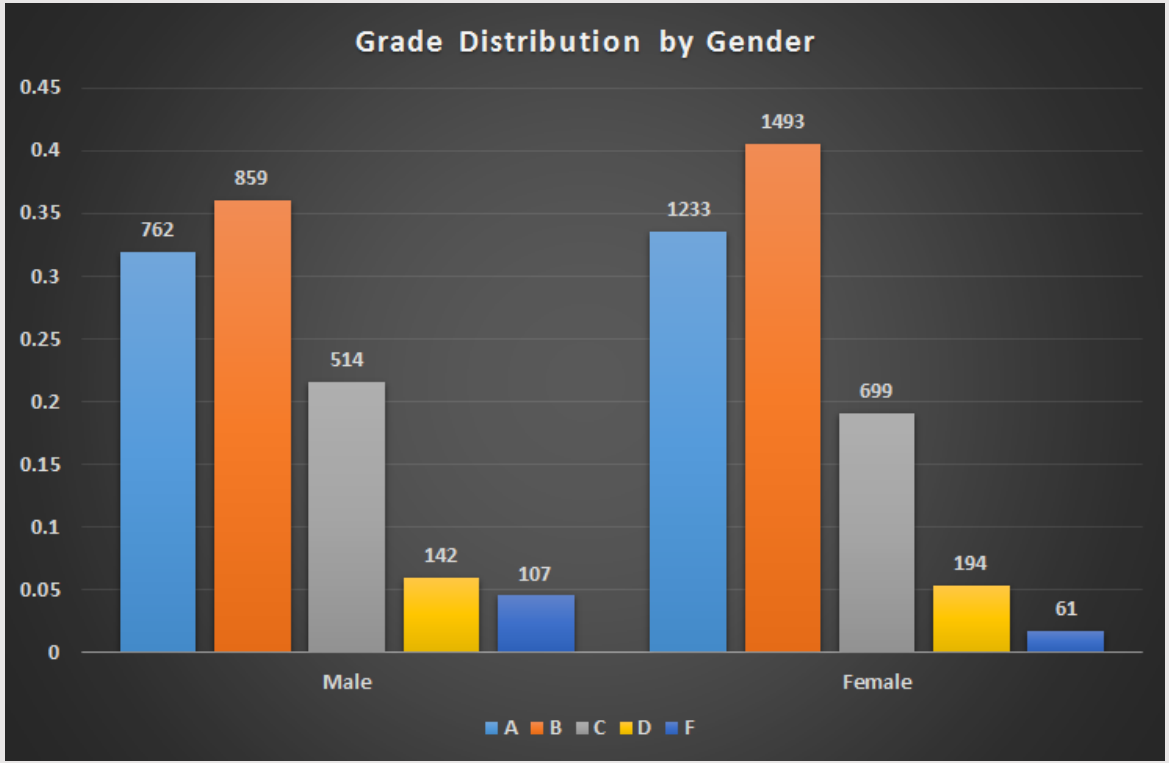


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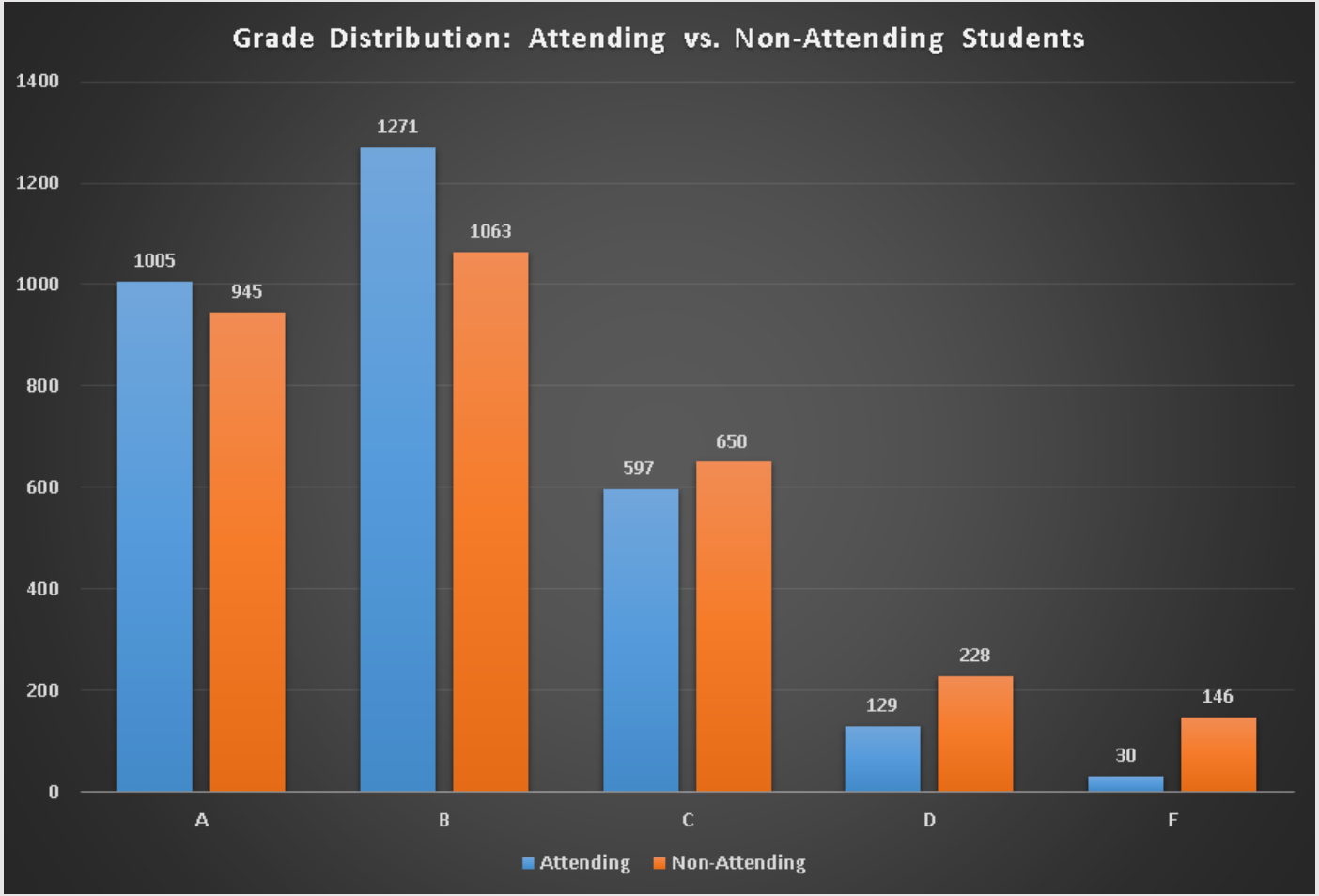

Grade Distribution: Attending vs. Non-Attending Students
1400
1200
1000
800
600
400
200
0
1005
945
1271
1063
597
650
129
228
30
146
A
B
C
D
F
Attending
Non-Attending

# Propensity Score Analysis

- The goal of this analysis is to be able to take observational data and approach a controlled experiment to assess the treatment outcome.

- **Issue:** Selection bias prevents assessment of the causal effect of the SI program on grades. We control for the selection bias using Propensity Score Analysis.

- Propensity Score Analysis creates statistical control and treatment populations, which simulates a random experiment and allows for causal inference.

# Results

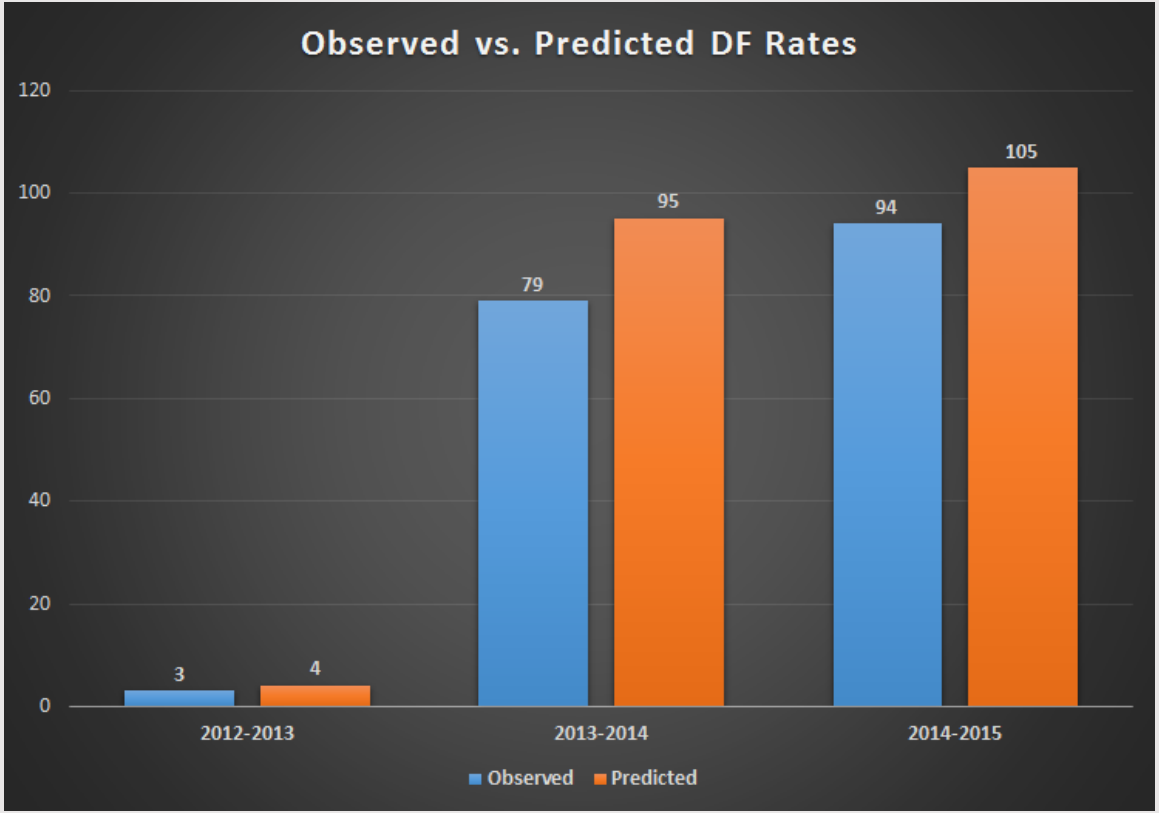
**A logistic model was built using the propensity data to predict the DF rates.**

**<u>Percent Change</u>:**

2012-2013: **-25.0%**

2013-2014: **-16.8%**

2014-2015: **-10.5%**




*Academic Year 2012-2013 does not include the fall semester.*

# Ordinal Logistic Model

- The ordinal logistic model is used to predict the grade that a student will receive in the course.
- The model produces the marginal probability that a student's grade will change from F to D, D to C, and so on.
- The transition state with the largest probability is therefore the predicted course grade.

# Ordinal Logistic Regression Results

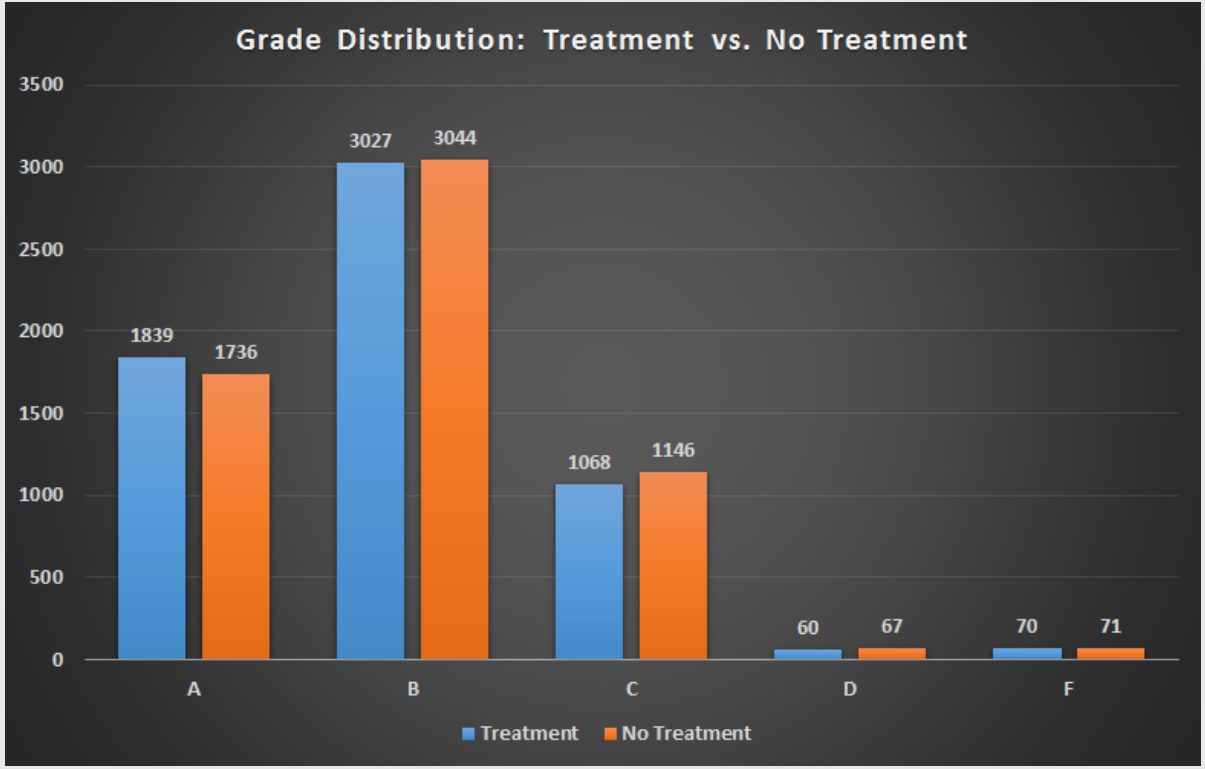
| Variable | 95% Confidence Interval | Mean | Significance |
|---|---|---|---|
| Term Hours Attempted | (0.987, 0.989) | 0.988 | 99% |
| Cumulative Hours Attempted | (1.029, 1.031) | 1.030 | 99% |
| Cumulative Institutional GPA | (4.071, 4.104) | 4.088 | 99% |
| Average Grade for Course Section | (11.223, 11.314) | 11.268 | 99% |
| High School GPA | (4.513, 4.572) | 4.540 | 99% |
| SAT Scores (Math and Critical Reading Only) | (1.244, 1.249) | 1.246 | 99% |
| Grant Recipient (Not Need-Based) | (1.560, 1.579) | 1.570 | 99% |
| Population of Hometown over 25 w/ Bachelors Degree | (3.307, 3.401) | 3.353 | 99% |
| **Total SI Sessions Attended During the Semester** | **(1.060, 1.062)** | **1.061** | **99%** |

**Coefficients have been exponentiated to yield odds rather than log-odds.**

# Results

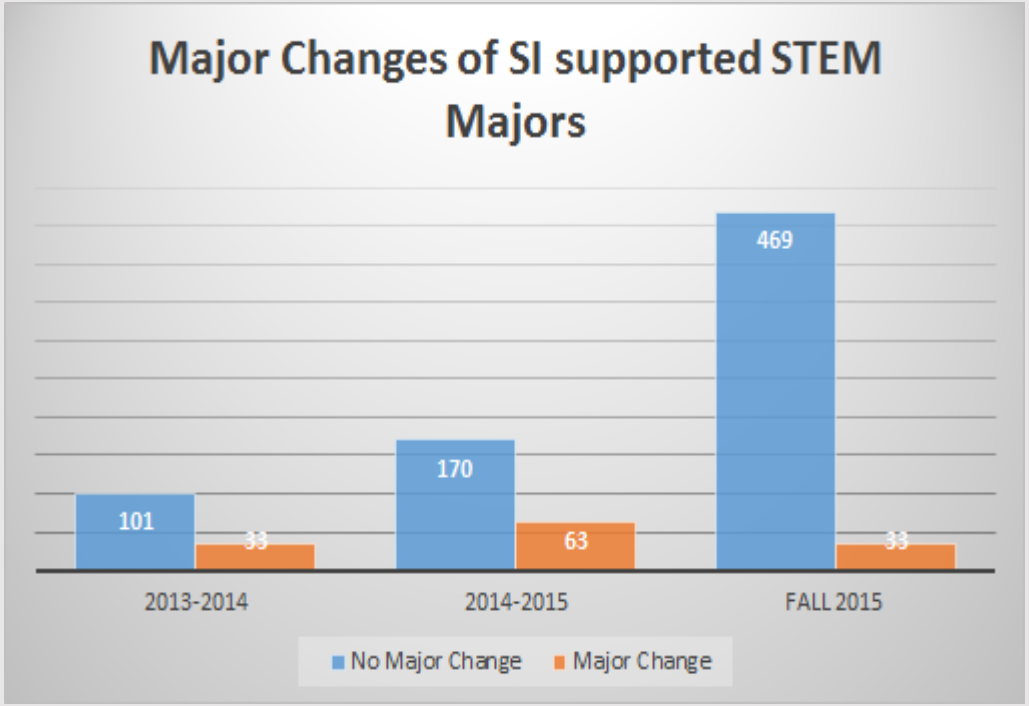
| Criteria | A | DF |
|---|---|---|
| With Treatment | 1839 | 130 |
| Without Treatment | 1736 | 138 |
| Percent Change | +6% (103) | –6% (8) |

**Treatment** is defined as the student's utilization of Supplemental Instruction.



# Survival Model

- Used to predict the likelihood that student in the current term will change their major in the succeeding term



# Survival Regression Results

| Variable | 95% Confidence Interval | Mean | Significance |
|---|---|---|---|
| Term Hours Attempted | (-0.098, -0.088) | -0.093 | 99% |
| Cumulative Hours Attempted | (-0.120, -0.196) | -0.198 | 99% |
| Cumulative Institutional GPA | (-0.756, -0.724) | -0.740 | 99% |
| Total Number of Give Center Hours | (0.003, 0.004) | 0.003 | 99% |
| Major: Math, Physics, Comp. Sci | (-1.922, -1.862) | -1.891 | 99% |
| Major: Environmental Science, Chemistry, Biology | (-2.341, -2.294) | -2.317 | 99% |
| Number of Semesters being Grant Recipient (Not Need-Based) | (0.308, 0.322) | 0.315 | 99% |
| Population of Hometown over 25 w/ Bachelors Degree | (0.286, 0.304) | 0.295 | 99% |
| SAT Scores (Math Only) | (0.218, 0.246) | 0.232 | 99% |
| **Total SI Visits** | **(0.018, 0.026)** | **0.022** | **99%** |
| **Total Number of SIs** | **(0.145, 0.177)** | **0.161** | **99%** |
| **(Total SI Visits) * (Total Number of SIs)** | **(-0.011, -0.008)** | **-0.009** | **99%** |

# Fiscal Considerations

- **Total SI Costs (FY 2015): $ 146,630**
- **Cost per additional A, B, or C: $ 5,237**
- **Cost per grade improvement: $ 620**
- **Est. Cost for 100 more improvements: $ 62,000**

# Implications and Recommendations

- **We see a positive effect of the SI program overall; we wish to investigate individual SI Leaders to identify training needs.** Modify surveys to track the performance of SI Leaders.
- **We see that the SI program greatly enhances a student's ability to improve their grade, helping 103 more students earn A's and keeping 8 more students from having to repeat the course.** Expand the program to more at-risk courses (i.e. courses with a high DF rate).
- **We anticipate that the SI program has a positive effect on STEM retention.** Have focus groups with students who changed from their STEM majors to clarify the issues that they confront.
- **We see that 27% of targeted courses had access to SI.** Encourage instructors to utilize SI in their courses.

# Further Research

- Consider Ws in our analysis. *This would require a model for persistence in the course.*
- Incorporate information about the individual SI Leaders. *This would allow us to control for variability in SI Leader styles, strengths, etc.*
- Qualitative information (testimonials from students, etc.).
- Consider the effect of a student attending SIs session within their major on their major retention.
- Look at major retention within the STEM field itself, rather than specific major

# Acknowledgements


- GC Office of Institutional Research and Effectiveness
- GC Center for Student Success
- GC Office of the Provost and Vice President for Academic Affairs
- USG STEM Development Phase Grant