SCS Noonan Scholars Program: Analysis of the 2012-2020 Cohorts

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1 Introduction

SCS Noonan Scholars is a 501(c)(3) organization dedicated to helping high-achieving low-income underrepresented students get into and graduate from top colleges equipped to achieve their full career potential. This program was originally established in 2001 by philanthropists James and Patricia London under the name South Central Scholars, and began as a scholarship program serving a few high-achieving low-income students in the Los Angeles area. The program quickly grew in scope to include academic intervention, academic and social-emotional support, and career guidance and networking. In 2012, SCS conducted a pilot summer program ("Summer Academy") to ensure that all participating Scholars enter college with the prerequisite writing, math, and science skills needed to persist in their chosen majors. In 2014, this program was replicated in Boston, Massachusetts under the name Noonan Scholars and in 2017, the Los Angeles and Boston programs unified under the name SCS Noonan Scholars.

This report details the results of an independent analysis commissioned by SCS Noonan Scholars during July-August 2019. The purpose of this analysis is threefold:

1. To evaluate the impact of the SCS Noonan Scholars Program since 2012.
2. To quantify the effects of attending Summer Academy on Scholars' academic performance.
3. To document additional observations and recommendations for future development.

The analysis was conducted by Dr. R. Jordan Crouser. Dr. Crouser earned his doctorate in Computer Science from Tufts University in 2013, and has held academic and research positions in both Statistical & Data Science and Computer Science. He served as an instructor at Summer Academy during 2018 and 2019.

2 About the Data

Two datasets were furnished by SCS Noonan Scholars for the purposes of this analysis.

2.1 Scholar Metadata (`Scholar Metadata.csv`)

The first dataset contains a variety of demographic and summary academic performance measurements on 1029 individual participating Scholars from 2012 to 2020. From this collection, 66 were removed from the analysis due to missing or incomplete data, resulting in a final dataset reflecting 608 current Scholars and 355 program alumni. To preserve Scholars' privacy, names and contact information have been omitted from this analysis. Throughout the remainder of this document, the term **cohort** (labeled with a year, e.g. "the 2019 cohort") will be used to refer to the group of Scholars who graduated high school in that year. For detailed information regarding the other measures in this dataset, see Appendix I.

2.1.1 General Characteristics at a Glance

- An average of 107 Scholars were accepted into each of the 2012-2020 cohorts.
- Out of the 963 Scholars in the dataset:
  - 945 (98.1%) come from families whose income is at or below 400% of the Federal Poverty Level.
  - 757 (79.0%) are first-generation college students.
  - 582 (60.5%) are female, yielding a sex ratio of 1.532.
  - 510 (53.0%) identify as Hispanic or Latinx.
  - 303 (31.5%) identify as Black or African-American.
  - 157 (16.3%) identify as Asian.

– 151 (15.7%) identify as multiracial.

2.1.2 High School GPA

The SCS Noonan Scholars program is becoming increasingly competitive. Data regarding High School GPA at time of admission was tracked beginning in 2016:

- In 2016, the average High School GPA was **3.71**.
- This average has **increased every year since that time**.
- The average High School GPA for the most recent 2020 cohort is **3.93**.

Table 1 illustrates the year-by-year trend in Scholar's high school GPA upon admission. *Note: the `% missing` column indicates how many Scholars in each cohort are missing a value for this measure in the dataset.*

Table 1: Average HS Unweighted GPA at Admission

Cohort	Average HS Unweighted GPA	% missing
2016	3.71	1.72%
2017	3.72	0%
2018	3.80	0%
2019	3.87	0%
2020	3.93	0%

The density plot in Figure 1 highlights the changing distribution of Scholars' High School GPA upon admission each year beginning in 2016. The distribution is becoming increasingly right-skewed over time: the average is getting higher, and the difference between the lowest- and highest-performing students is getting smaller.

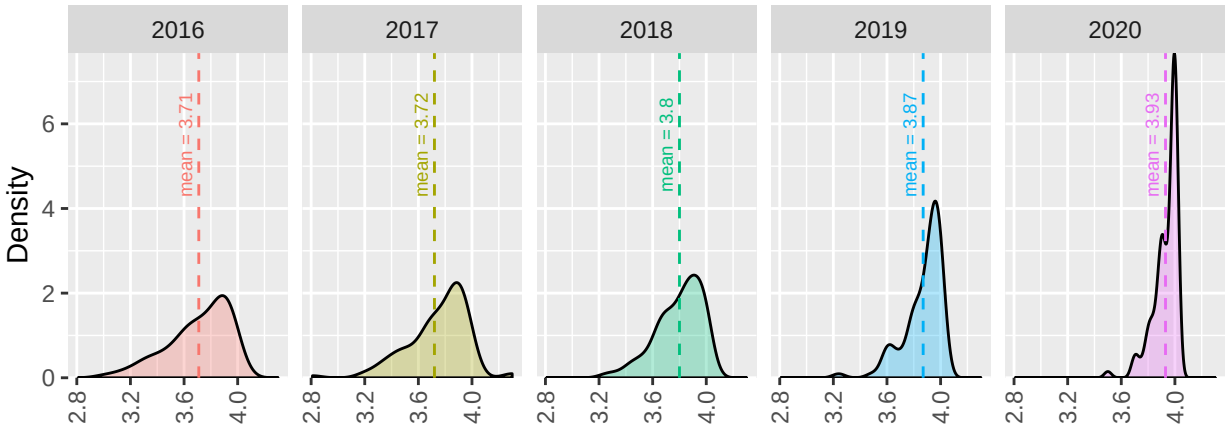

Fig. 1 Average High School GPA upon Admission to SCS Noonan Scholars

2.1.3 High School SAT Scores

The average SAT Percentile is also steadily increasing:

- For the 2012 cohort, the mean score was in the **78th percentile**.
- For the 2019 cohort, the mean score was in the **86th percentile**.

Table 2 captures the historic trend toward higher SAT scores with each new cohort. This data was generated by cross-referencing each Scholar's reported total SAT score with the percentile ranges provided by the College Board for the year in which the examination was taken.

Table 2: Average Composite SAT Percentile, by Cohort

Cohort	Average SAT Percentile	% missing
2012	77.9	2.34%
2013	76.2	6.00%
2014	75.7	5.32%
2015	73.9	6.36%
2016	73.9	6.03%
2017	80.2	10.7%
2018	82.3	41.6%
2019	85.7	42.4%

The boxplot in Figure 2 illustrates the spread of SAT Percentile by cohort. Note that the only statistically significant year-over-year difference was between the 2016 and 2017 cohorts.

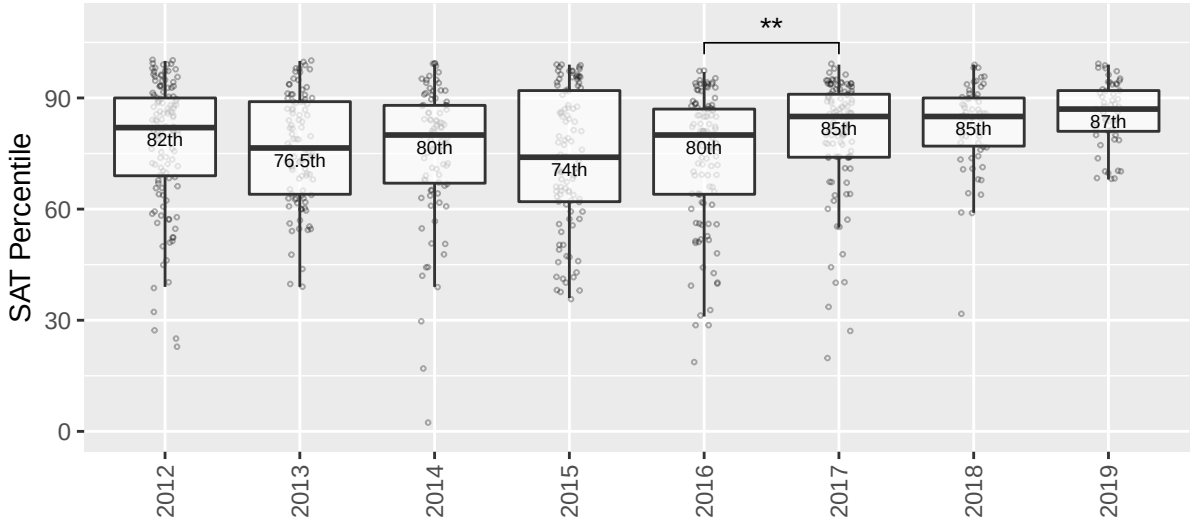

Fig. 2 Distribution of SAT Percentile by Cohort

2.1.4 Income Levels

More than 98% of Scholars have had family incomes at or below 400% of the Federal Poverty Level during each of the previous 3 cohorts, and 6 out of the last 9 cohorts (Table 3).

Table 3: % of Scholars, by % Federal Poverty Level and Cohort

Cohort	% of Scholars w/ Family Income < 200% FPL	% of Scholars w/ Family Income < 400% FPL	% missing
2012	77.3%	94.5%	0%
2013	84.0%	100%	0%
2014	77.7%	100%	0%
2015	77.3%	98.2%	0%
2016	84.5%	97.4%	0%
2017	80.3%	97.5%	0%
2018	86.1%	99.0%	0%
2019	79.3%	100%	0%
2020	75.0%	98.0%	0%

The average family income has been **below $40,000** for each cohort since 2012.

Table 4: Average Family Income, by Cohort

Cohort	Average Family Income	% missing
2012	$35,573	1.56%
2013	$32,270	3.00%
2014	$36,214	0%
2015	$35,941	0%
2016	$33,113	0%
2017	$36,825	2.46%
2018	$32,010	0%
2019	$36,870	1.09%
2020	$37,671	0%

2.1.5 Race and Ethnicity

Across all cohorts:

- **31.5%** of Scholars identify as Black or African American.
- **53.0%** of Scholars identify as Hispanic or Latinx.
- **81.3%** of Scholars identify as one or more of Black, African American, Hispanic or Latinx.
- **78.6%** are first-generation college students.

Table 5: Proportion of Scholars, by Race and Cohort

Cohort	% Black and/or African American	% Hispanic and/or Latinx	% Black, African American, Hispanic, and/or Latinx	% First Generation
2012	27.3%	46.9%	74.2%	53.9%
2013	35.0%	44.0%	79.0%	73.0%
2014	30.9%	40.4%	70.2%	73.4%
2015	31.8%	48.2%	80.0%	84.5%
2016	29.3%	68.1%	88.8%	85.3%
2017	25.4%	64.8%	84.4%	87.7%
2018	25.7%	60.4%	79.2%	86.1%
2019	38.0%	48.9%	85.9%	83.7%
2020	43.0%	51.0%	90.0%	83.0%

2.2 Scholar Transcripts (`Scholar Transcripts.csv`)

This dataset contains detailed information on 767 unique Scholars from the 2012-2018 cohorts regarding their performance in 20,649 individual courses throughout their college career. Of the unmatched students in the `Scholar Metadata` dataset, 192 are from the 2019 and 2020 cohorts (and so have not yet completed their first semester of college).

The following summary statistics report only on those Scholars who have completed at least one semester of college. For detailed information regarding the measures in this dataset, see Appendix II.

2.2.1 General Characteristics at a Glance

- Scholars took an average of **4.05** courses each term.
- Table 6 breaks this down by individual terms. We observed a heavier load during the traditional Fall and Spring semesters, with a lighter courseload during Summer and Winter terms across all cohorts, with the 2018 cohort taking a heavier overall courseload than any previous cohort:

Table 6: Average Courseload by Academic Term

Cohort	Fall	Spring	Summer	Winter
2012	4.403	4.498	2.241	3.650
2013	4.160	4.172	2.356	3.701
2014	4.241	4.291	2.018	3.364
2015	4.119	4.199	2.574	3.243
2016	4.238	4.403	2.345	3.431
2017	4.271	4.460	2.667	3.636
2018	4.525	5.238	3.667	2.500

- Out of the 767 Scholars in the dataset:
  - 553 (72.1%) enrolled in at least one **Mathematics or Statistics course in their Freshman year**, earning an average normalized Course GPA of 2.78. Of the 1,037 Mathematics or Statistics courses taken by Scholars in their Freshman year, 60 resulted in withdrawl or failure.
  - 474 (61.8%) enrolled in at least one **English or Literature course in their Freshman year**, earning an average normalized Course GPA of 3.28. Of the 717 English or Literature courses taken by Scholars in their Freshman year, 7 resulted in withdrawl or failure.
  - 127 (16.6%) enrolled in at least one **Computer Science course in their Freshman year**, earning an average normalized Course GPA of 2.84. Of the 209 Computer Science courses taken by Scholars in their Freshman year, 16 resulted in withdrawl or failure.
  - 108 (14.1%) enrolled in at least one **Engineering course in their Freshman year**, earning an average normalized Course GPA of 3.3. Of the 208 Engineering courses taken by Scholars in their Freshman year, 5 resulted in withdrawl or failure.
- **STEM disciplines account for 40.2% of all course attempts**, and comprise 3 of the top 5 categories by Scholar enrollment (Table 7).
- Scholars have an **overall pass rate of 97.3% across all disciplines**, and earn a **B or above in 64.4% of all course attempts** (Table 7).

Table 7: Top Disciplines by Course Enrollment, with Metrics

Discipline (NCES Categorization)	Courses Passed	Failed / Withdrawn	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
Social Sciences.	2686	69	97.5%	68.6%	52.6%	37.1%
Physical Sciences.	2162	104	95.4%	45.5%	28.0%	19.0%
Mathematics & Statistics.	1824	113	94.2%	47.0%	32.0%	23.5%
Area, Ethnic, Cultural, Gender, & Group Studies.	1369	14	99.0%	80.9%	69.3%	55.9%
Biological & Biomedical Sciences.	1333	39	97.2%	54.4%	35.6%	25.5%

There are three disciplines (Table 8) in which Scholars earn a B or above in fewer than half of all attempts:

Table 8: Disciplines with <50% satisfactory marks (B and above)

Discipline (NCES Categorization)	Courses Passed	Failed / Withdrawn	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
Mathematics & Statistics.	1824	113	94.2%	47.0%	32.0%	23.5%
Physical Sciences.	2162	104	95.4%	45.5%	28.0%	19.0%
Parks, Recreation, Leisure, & Fitness Studies.	120	1	99.2%	37.2%	33.9%	29.8%

Drilling down further, we observe that there are 6 individual courses (Table 9) with a pass rate under 95%, all of them within STEM disciplines. (*Note: we consider only courses with at least 100 attempts.*)

Table 9: Courses with <95% pass rate

NCES Course	Courses Passed	Failed / Withdrawn	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
Computer Engineering.	98	9	91.6%	57.9%	43.0%	33.6%
Calculus 2.	342	27	92.7%	46.9%	29.3%	19.5%
Calculus 1.	335	25	93.1%	45.0%	32.5%	23.9%
Organic Chemistry.	216	16	93.1%	50.9%	32.3%	22.4%
Computer Science.	512	28	94.8%	57.2%	44.6%	35.4%
Chemistry.	1019	55	94.9%	43.4%	24.4%	15.9%

3 Impact of the SCS Noonan Scholars Program

In the following sections, we report on the overall impact the SCS Noonan Scholars Program has had on participating Scholars, and how that has evolved over the past 8 years.

3.1 Where SCS Noonan Scholars Attend College

Scholars are enrolling in increasingly selective colleges and universities. The 2019 cohort saw a dramatic shift in the caliber of postsecondary institutions into which Scholars ultimately enrolled (Table 10). More than **1 in 4 Scholars** in the 2019 cohort will be attending Ivy-Plus instituions[1] in the Fall of 2019, and over **90%** will be attending a Top-100 institution.

Table 10: % Scholars Attending Top Schools, by Cohort

Cohort	% attending Ivy-Plus School	% attending Top-100 School	% missing
2012	19.5%	83.6%	0%
2013	14.0%	84.0%	0%
2014	11.7%	72.3%	0%
2015	13.6%	75.5%	0%
2016	13.8%	80.2%	0%
2017	15.6%	86.1%	0%
2018	9.90%	77.2%	0%
2019	26.1%	90.2%	1.09%

Scholars attend a wide variety of different colleges and universities (Table 11). California institutions dominated the landscape in the early years of the program, shifting after the program went national in 2018.

[1]The Ivy-Plus instituions are a collection of elite colleges and universities esteemed for their academic and professional excellence, intellectual curiosity, leadership and civic engagement. The twelve schools under this designation are: Brown University, Columbia University, Cornell University, Dartmouth College, Harvard University, University of Pennsylvania, Princeton University, Yale University, Stanford, Massachusetts Institute of Technology, University of Chicago, Duke University.

Table 11: Top 10 Colleges or Universities by Enrollment, 2012 vs. 2019

Cohort	Institution	# Scholars Enrolled
2012	1. UC Los Angeles	17
2012	10. Pomona College	4
2012	2. University of Southern California	13
2012	3. Brown University	9
2012	4. UC Berkeley	7
2012	5. Harvard University	5
2012	6. Loyola Marymount University	5
2012	7. Wellesley College	5
2012	8. Franklin and Marshall College	4
2012	9. Georgetown University	4
2012	(39 Other Institutions)	55
2019	1. UC Los Angeles	6
2019	10. Stanford University	3
2019	2. Amherst College	5
2019	3. UC Irvine	5
2019	4. Boston University	4
2019	5. Dartmouth College	4
2019	6. Duke University	4
2019	7. Harvard University	4
2019	8. Massachusetts Institute of Technology	3
2019	9. Rice University	3
2019	(37 Other Institutions)	50

3.2 Major Distribution

Of the 902 Scholars that indicated an intended major, **516 (57.2%) intended to major in STEM fields**. Of these:

- 285 were female/non-binary (52.3% of Scholars coded as female/non-binary with an intended major).
- 271 identify as Hispanic or Latinx (57.3% of Hispanic or Latinx Scholars with an intended major).
- 164 identify as Black or African American (58.8% of Black or African American Scholars with an intended major).

The top 10 intended majors by popularity appear in Table 12.

Table 12: Top Intended Majors by Popularity

Intended Major	Number of Scholars
1. Biological & Biomedical Sciences	168
2. Engineering	145
3. Economics, Sociology, Political Science, & Related Fields	116
4. Health Professions & Related Programs	74
5. Business, Management, Marketing, & Related Support Services	69
6. Computer & Information Sciences & Support Services	54
7. Mathematics & Statistics	31
8. Physical Sciences	30
Psychology	30

Intended Major	Number of Scholars
10. English Language & Literature/Letters	19

The top 10 majors at graduation by popularity appear in Table 13.

Table 13: Top 10 Majors Upon Graduation by Popularity

Current Major Category	Number of Scholars
1. Economics, Sociology, Political Science, and Related Fields	57
2. Biology	53
3. Business	33
4. Engineering	32
5. Health Professions	22
6. Area Studies	20
7. Psychology	19
8. Multi/Interdisciplinary Studies	14
Computer Science	13
10. Math & Stats	12

3.3 Scholar Graduation Rate

The six-year college graduation rate of the Scholars contained in the provided datasets is **98.2%** (calculated for 2012 and 2013 cohorts only), and the four-year graduation rate is **83.3%**. Table 15 breaks this figure down by cohort, and was prepared using a Scholar's status (`Scholar Alumni` or `Current Scholar`) as an indicator of whether or not they had completed their degree. Scholars in cohorts later than 2015 have not yet reported their degrees, and so are omitted from this analysis. The `% missing` column details the proportion of Scholars in each cohort whose listed `College Graduation Year` is 2019 or earlier, but whose degrees have not yet been confirmed.

Table 14: % Scholars Graduating, by # Years, by Cohort

Cohort	Degree in <= 4 Years	Degree in <= 5 Years	Degree in <= 6 Years	Degree in > 6 Years	Still in school as of August 2019	% missing
2012	84.4%	96.1%	98.4%	0.781%	0.781%	0%
2013	82.0%	98.0%	98.0%	0%	1.00%	1.00%

All 33 Scholars from the 2012 and 2013 cohorts that attended Top-100 Schools graduated within 6 years. According to data made available through the National Center for Education's Integrated Postsecondary Education Data System (IPEDS), the 6-year graduation rate for all students attending Forbes 2018 Top-100 ranked schools is 89%: SCS Noonan Scholars graduate at a rate **10.7% higher than the average students** enrolled at the nation's most competitive institutions.

Table 15: % Scholars Graduating, by # Years, by Cohort

Degree in <= 4 Years	Degree in <= 5 Years	Degree in <= 6 Years	Degree in > 6 Years	Still in school as of August 2019	% missing	n
84.8%	96.9%	98.4%	0.524%	0.524%	0.524%	191

3.4 Scholar Grades

Across all cohorts, **68.7%** of Scholars have a collegiate GPA above 3.0 (Table 16):

- For female Scholars, the rate is **71.9%**
- For Black, African American, Hispanic, and Latinx Scholars, the rate is **66.6%**

Table 16: Proportion of Scholars with a Collegiate GPA >= 3.0

Cohort	Average GPA	Current GPA >= 3.0	Current GPA < 3.0	Missing Current GPA	Number Graduated to Date
2012	3.184	71.1%	28.1%	1 / 128	128 / 128
2013	3.190	72.0%	28.0%	0 / 100	98 / 100
2014	3.200	70.2%	29.8%	0 / 94	83 / 94
2015	3.173	67.3%	32.7%	0 / 110	46 / 110
2016	3.124	60.3%	39.7%	0 / 116	0 / 116
2017	3.169	66.4%	33.6%	0 / 122	0 / 122
2018	3.229	75.0%	24.0%	1 / 100	0 / 100

3.5 STEM Persistence

Across all cohorts, **64.5%** of Scholars who intend to major in STEM go on to graduate with a STEM degree (Table 17):

- For female Scholars, the rate is **58.6%**.
- For Black and African American scholars, the rate is **57.7%**,
- For Hispanic and Latinx Scholars, the rate is **64.0%**.

Table 17: STEM Persistence, by Cohort

Cohort	# Persisted in STEM	% Persisted in STEM
2012	39 / 57	68.4%
2013	25 / 48	52.1%
2014	29 / 42	69.0%
2015	18 / 25	72.0%

4 Impact of Summer Academy on Academic Performance

4.1 The Origin of Summer Academy

Several years into the development of the program, organizers observed that a nontrivial number of Scholars were transitioning out of their intended majors after struggling academically during their Freshman year. Specifically, they were concerned by the perceived trend that Scholars were abandoning traditionally rigorous majors about which they felt passionate, and moving into fields of study in which they believed they could achieve a higher GPA regardless of whether that discipline held their interest.

The organizers hypothesized that a gap in academic preparedness was in part responsible for Scholars' early challenges in collegiate environments, specifically in the areas of mathematics and writing. The Summer Academy program was launched in 2012 in an effort to bridge this gap. In this section, we attempt to quantify the impact of this program with respect to Scholars' post-secondary academic performance.

Table 18 illustrates the growth of participation in the Summer Academy program since its inception in 2012. In earlier years, each cohort was triaged to identify Scholars who would most benefit from additional support through this program. The 2012 cohort, which was the first cohort to participate in Summer Academy, only had the opportunity to attend a single session prior to leaving for college. In later years, all Scholars were strongly encouraged to attend, and some had the opportunity to attend a second session.

Table 18: Participation in Summer Academy, by Cohort

Cohort	Did not attend Summer Academy	Attended 1 Session of Summer Academy	Attended 2 Sessions of Summer Academy
2012	95 Scholars (74%)	33 Scholars (26%)	–
2013	56 Scholars (56%)	39 Scholars (40%)	5 Scholars (4%)
2014	26 Scholars (28%)	41 Scholars (44%)	27 Scholars (28%)
2015	25 Scholars (22%)	62 Scholars (56%)	23 Scholars (20%)
2016	25 Scholars (22%)	64 Scholars (56%)	27 Scholars (24%)
2017	18 Scholars (14%)	73 Scholars (60%)	31 Scholars (26%)
2018	26 Scholars (26%)	55 Scholars (54%)	20 Scholars (20%)
2019	–	48 Scholars (52%)	44 Scholars (48%)

During their first session of Summer Academy, all Scholars took one course in Calculus-based mathematics and one course in college-level writing. Beginning in 2014, those that attended a second session in Los Angeles had the option to select a Chemistry elective in lieu of either mathematics of writing. In 2015, a second elective in Computer Science was added. In 2018, the Chemistry elective was discontinued.

4.2 Confounding Factors

The question of whether or not participation in Summer Academy is correlated with improved post-secondary outcomes is somewhat complex, due in large part to the absence of an appropriate control group:

- Because Scholars in this program are statistical outliers in their academic achievement prior to their enrollment, and because systemic racism and classism heavily influence access to education, **comparison with national averages** for students with similar socioeconomic, racial, and ethnic demographics is not appropriate.
- Because they attend such a wide variety of postsecondary institutions (many of which have historically had substantial underrepresentation of low income students and students of color), a **comparison with similar students at the same institution** is not possible.
- Because the program has evolved so much in the past several years, even a **comparison between Scholars who did and did not attend Summer Academy** can prove problematic if not approached with care.

For example, because of the targeted recruitment strategy for earlier cohorts and the later shift toward required participation for all Scholars, the probability that an individual Scholar participated in Summer Academy grows each year (regardless of other factors). The logistic regression line in Figure 3 captures this pattern.

Note: for illustrative purposes, each black point represents an individual Scholar from the cohort, and the position encodes the true outcome: if the Scholar attended Summer Academy then the corresponding point appears at 100%, and if the Scholar did not attend Summer Academy, then the point appears at 0%.

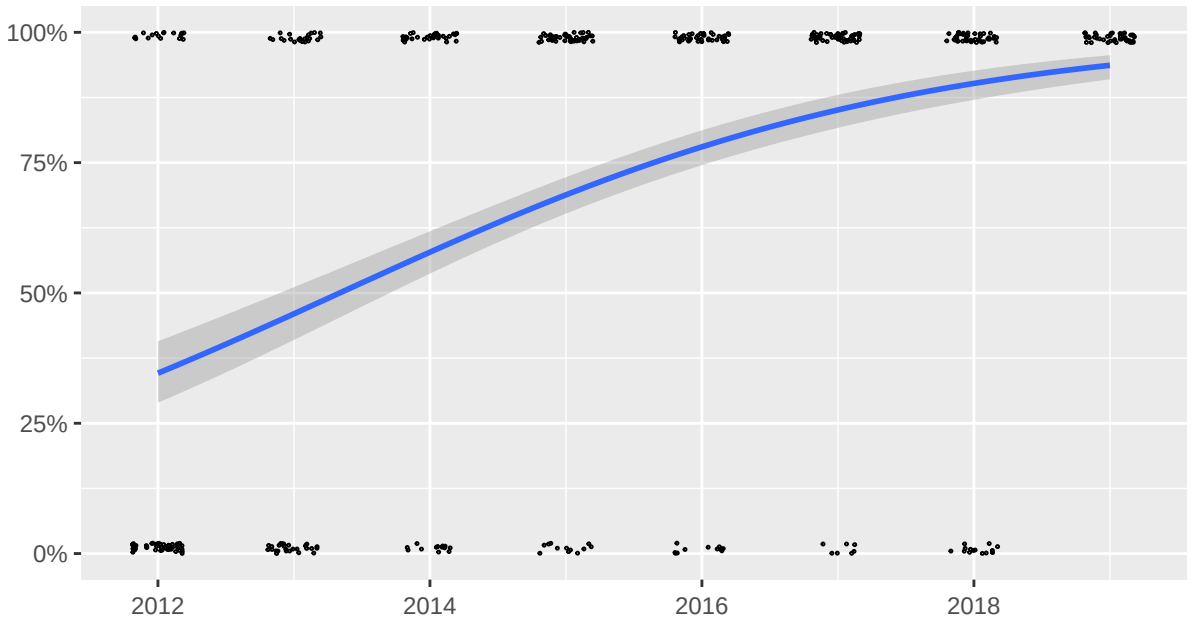

Fig. 3 Logistic Regression: Probability of Attending SA by Cohort

Similarly, for the first several years of the program, Scholars were selected for participation in Summer Academy specifically because they needed additional support. This suggests that in the years where Summer Academy was optional (prior to the 2019 Cohort), the probability that an individual Scholar participates in Summer Academy would decrease the more academically-prepared they were at the time of recruitment. The Scholar's performance on standardized testing could serve as one proxy measure for this (Figure 4).

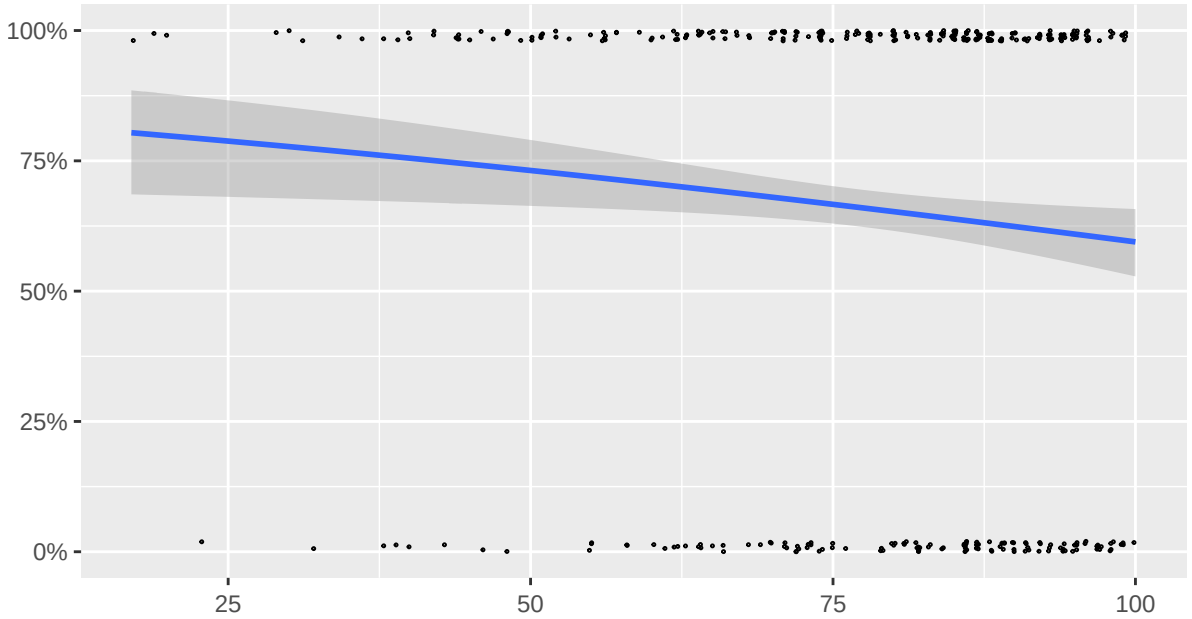

Fig. 4 Logistic Regression: Probability of Attending SA by SAT Percentile

However, this isn't quite the whole story:

- Using Pearson's method we also observe a **weak positive correlation** (0.1924, $p < 0.0001$) between SAT Percentile and Reported Total GPA: as SAT scores increase, so does college GPA.
- Intuitively, there is also **moderate negative correlation** between SAT scores and College Ranking (-0.4166, $p < 0.0001$): as SAT scores increase, the Scholar's chosen college is ranked closer to number 1.

- However, we also observe is a **weak negative correlation** between (the log of) College Ranking and a Scholar's GPA (-0.1739, $p < 0.0001$): as the school's ranking gets closer to 1, their GPA goes down.

This implies that while higher SAT scores predispose a Scholar to enrolling in a higher-ranked college, as well as indicate prior preparation that equips them to do better on average in school than someone with a lower score, the decision to attend a higher-ranked school is related to lower overall GPAs. Because of the interrelationship between the aforementioned variables, the subsequent analysis will attempt to capture the impact of Summer Academy **in the context of** these factors rather than in isolation.

4.3 Impact on Overall Academic Performance

In this section, we consider the relationship between participation in Summer Academy and general academic performance in college. For this analysis, we will consider only Scholars whose status is listed as `Scholar Alumni`. When we account for each Scholar's SAT Percentile as well as the selectivity of their College:

- We observe **a statistically significant relationship between the number of sessions of Summer Academy a Scholar attends and their overall performance in college** ($p < 0.00001$).
- The coefficient suggests that we would expect to see **an average increase of 0.058** in overall GPA upon graduation for those who attend one session of Summer Academy, and **an average increase of 0.193** for those who attend two sessions of Summer Academy.
- For **female Scholars**, these gains are even more substantial: we would expect to see **an average increase of 0.128** in overall GPA upon graduation for those who attend one session of Summer Academy, and **an average increase of 0.253** for those who attend two sessions of Summer Academy ($p < 0.0001$).
- Scholars who identify as **Black, African American, Hispanic, or Latinx** reap benefits comparable to the overall collection of Scholars: we would expect to see **an average increase of 0.053** in overall GPA upon graduation for those who attend one session of Summer Academy, and **an average increase of 0.206** for those who attend two sessions of Summer Academy.

4.4 Impact on Mathematics Performance

4.4.1 Overall Mathematics Performance

We observe several patterns in Scholar's performance in mathematics courses across **all years of college** (Table 19):

- Scholars who participated in Summer Academy **enrolled in Calculus I** at some point in their college careers at a higher rate than those who did not participate in Summer Academy.
- Scholars **earned a B or above more frequently in all categories of mathematics** when they had taken at least one session of Summer Academy.
- Scholars also **earned a B+ or above more frequently in all categories of mathematics** when they had taken at least one session of Summer Academy.
- Those gains were most striking in higher level mathematics courses (levels C and above), but this may be an artifact of relatively small n.

Table 19: Performance in Math Courses: All Years

Math Category	# SA Cohorts	Scholars taking Math Course	Avg. # Courses per Scholar	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
Pre-calculus Math	No SA	28 / 371 = 7.5%	1.4	94.7%	50.0%	31.6%	23.7%

Math Category	# SA Cohorts	Scholars taking Math Course	Avg. # Courses per Scholar	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
Pre-calculus Math	1 Year	44 / 415 = 10.6%	1.3	84.7%	47.5%	33.9%	28.8%
Pre-calculus Math	2 Years	19 / 177 = 10.7%	1.4	84.6%	53.8%	30.8%	30.8%
Calculus I	No SA	107 / 371 = 28.8%	1.5	87.8%	41.0%	30.8%	21.8%
Calculus I	1 Year	150 / 415 = 36.1%	1.3	91.5%	46.8%	31.3%	23.9%
Calculus I	2 Years	59 / 177 = 33.3%	1.5	91.9%	51.2%	37.2%	29.1%
Calculus II	No SA	78 / 371 = 21.0%	1.5	82.2%	43.2%	26.3%	16.1%
Calculus II	1 Year	117 / 415 = 28.2%	1.3	82.2%	46.5%	29.3%	20.4%
Calculus II	2 Years	45 / 177 = 25.4%	1.4	87.7%	44.6%	23.1%	10.8%
Intermediate Math (200+)	No SA	55 / 371 = 14.8%	2.0	89.3%	38.4%	22.3%	11.6%
Intermediate Math (200+)	1 Year	86 / 415 = 20.7%	1.9	88.9%	52.5%	35.8%	26.5%
Intermediate Math (200+)	2 Years	39 / 177 = 22.0%	1.7	92.4%	39.4%	24.2%	16.7%
Advanced Math (300+)	No SA	13 / 371 = 3.5%	1.8	95.7%	30.4%	26.1%	21.7%
Advanced Math (300+)	1 Year	27 / 415 = 6.5%	1.6	86.4%	59.1%	45.5%	25.0%
Advanced Math (300+)	2 Years	6 / 177 = 3.4%	2.0	100%	58.3%	41.7%	33.3%
Statistics	No SA	147 / 371 = 39.6%	1.4	91.5%	49.2%	33.2%	25.6%
Statistics	1 Year	149 / 415 = 35.9%	1.4	93.2%	51.2%	36.6%	30.2%
Statistics	2 Years	40 / 177 = 22.6%	1.2	92.0%	52.0%	40.0%	32.0%
Other	No SA	19 / 371 = 5.1%	1.4	100%	42.3%	19.2%	19.2%
Other	1 Year	39 / 415 = 9.4%	1.4	94.6%	44.6%	32.1%	30.4%
Other	2 Years	10 / 177 = 5.6%	1.4	100%	50.0%	28.6%	14.3%

```
## # A tibble: 1 x 2
##   `# Taking Calculus-Based Courses` `# Taking Statistics-Based Courses`
##                               <dbl>                               <dbl>
## 1                               443                                 336
```

4.4.2 Freshman Performance in the Introductory Calculus Series

In this section, we consider the relationship between participation in Summer Academy and performance in the introductory Calculus series: Calculus I and 2. Table 20 demonstrates that enrollment in the introductory Calculus series during Freshman year was robust across all cohorts through 2017 (the most recent cohort for which complete data is available on Summer Academy participation).

Table 20: Freshman Enrollment in Introductory Calculus Series

Math Category	2012	2013	2014	2015	2016	2017
Calculus I	82	64	53	62	64	52
Calculus II	42	18	33	29	31	47

A total of 379 unique Scholars took a total of 577 introductory Calculus courses during their Freshman year:

- They earned an average course GPA of 2.75.
- They had a pass rate of 94.3%
- 50.8% of attempts earned a B or above
- 34.3% of attempts earned a B+ or above
- 24.4% of attempts earned an A- or above.

Of these Scholars:

- 267 attended one session of Summer Academy.
- 114 attended two sessions of Summer Academy.
- 196 did not attend Summer Academy.

Table 21 demonstrates the **modest increase in the proportion of Scholars attempting Calculus I** during their first semester of college when they were exposed to Calculus during Summer Academy, as well as an **increase in the proportion of Scholars earning grades in each of the following three categories: B or above, B+ or above, and A**.

Table 21: Performance of Scholars taking Calculus: Freshman Fall

# SA Cohorts	Scholars taking Course	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
No SA	72 / 371 = 19.41%	90.4%	43.8%	32.9%	21.9%
1 Year	84 / 415 = 20.24%	96.4%	47.6%	36.9%	28.6%
2 Years	41 / 177 = 23.16%	95.2%	57.1%	42.9%	31.0%

4.5 Freshman Performance in Writing-Intensive Courses

A total of 585 unique Scholars took a total of 1558 courses in writing-intensive disciplines during their Freshman year of college, broken down in Table 22 by discipline and cohort:

Table 22: Freshman Enrollment in Writing-Intensive Disciplines

NCES Major Category	2012	2013	2014	2015	2016	2017
English Language & Literature/Letters.	138	110	84	127	111	108
Foreign Languages, Literatures, & Linguistics.	106	77	64	47	63	59
Philosophy & Religious Studies.	64	34	28	26	33	25
History.	36	27	30	22	27	18

NCES Major Category	2012	2013	2014	2015	2016	2017
Communication, Journalism, & Related Programs.	14	13	11	12	20	8
Legal Professions & Studies.	3	2	–	–	3	8

These attempts earned an **average course GPA of 3.29**, with a **pass rate of 98.3%** and with **75.7% of attempts earning a B or higher**. Of these Scholars:

- 268 attended one session of Summer Academy.
- 93 attended two sessions of Summer Academy.
- 224 did not attend Summer Academy.

Table 23 demonstrates the **modest increase in the proportion of Scholars attempting courses in a writing-intensive discipline** during their first semester of college when they were exposed to Writing during Summer Academy, as well as an **increase in the proportion of Scholars earning grades in each of the following three categories: B or above, B+ or above, and A- or above**.

Table 23: Performance of Scholars taking Writing: Freshman Fall

# SA Cohorts	Scholars taking Course	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
No SA	175 / 371 = 47.2%	98.1%	73.1%	55.7%	37.9%
1 Year	213 / 415 = 51.3%	96.4%	74.0%	60.9%	39.8%
2 Years	72 / 177 = 40.7%	99.1%	76.6%	55.1%	31.8%

When we account for each Scholar's score on the SAT Critical reading examination as well as the selectivity of their institution, we found **a statistically significant relationship ($p < 0.01$) between a Scholar's attendance at Summer Academy and their performance in Freshman Writing courses**. Specifically, we would expect to see **an average increase of 0.166** for those who attend one year of Summer Academy, and **an average increase of 0.168** those who attend two years of Summer Academy.

4.6 Impact of Summer Academy on STEM Disciplines

4.6.1 Performance in STEM Courses

The dataset includes records of 8,320 STEM courses taken by 630 unique Scholars. Scholars earned an **average course GPA of 2.81**, with a **pass rate of 94.4%**, with **51.4% of Scholars earning a B or higher** and **35.1% earning a B+ or higher**. Of these Scholars:

- 126 attended two sessions of Summer Academy.
- 344 attended one session of Summer Academy.
- 260 did not attend Summer Academy.

Controlling for differences in academic preparedness (using SAT Math score as a proxy) and institutional rigor, we observe a **statistically significant relationship ($p < 0.05$) between Scholars' performance in STEM courses and their participation in Summer Academy**. Specifically, the coefficient suggests that we would expect to see **an average increase of 0.042** in their GPA in STEM courses for those who attend one session of Summer Academy, and **an average increase of 0.082** for those who attend Summer Academy for a second session.

We found that Scholars who attended Summer Academy were **slightly more likely to enroll in a STEM course** than those who did not (Table 24), though performance is fairly consistent across all Scholars:

Table 24: Performance of Scholars taking STEM Courses

# SA Cohorts	Scholars taking STEM Course	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
No SA	260 / 371 = 70.1%	92.5%	50.9%	34.2%	24.7%
1 Year	344 / 415 = 82.9%	90.9%	51.2%	35.7%	26.6%
2 Years	126 / 177 = 71.2%	92.9%	53.3%	35.6%	26.3%

4.6.2 Incidence of STEM Majors and STEM Persistence

Scholars who attended Summer Academy were no more likely to intend to major in STEM than those who did not attend (Table 25):

Table 25: Prevalence of Intended STEM Major

# SA Cohorts	Intended non-STEM or Undeclared	Intended STEM Major
No Summer Academy	50.55%	49.45%
1 Session	53.44%	46.56%
2 Sessions	50.0%	50.0%

Nor were they more likely to ultimately major in STEM (Table 26):

Table 26: Prevalence of STEM Major

# SA Cohorts	Current non-STEM or Undeclared	Current STEM Major	
No Summer Academy	62.1%	37.4%	0.5%
1 Session	62.6%	37.4%	–
2 Sessions	61.9%	38.1%	–

Table 27 considers **only those Scholars who have completed their degree**. There is no evidence of a relationship between the number of SA Cohorts a Scholar attends and the rate at which they persist in STEM (when controlling for SAT Math scores and College Forbes Ranking).

Table 27: STEM Persistence

# SA Cohorts	# Persisted in STEM	% Persisted in STEM
No Summer Academy	59 / 90	65.6%
1 Session	39 / 61	63.9%
2 Sessions	13 / 21	61.9%

4.7 Impact on Women in STEM

Note: due to limitations in data collection, the following analysis considers only binary `Male` / `Female` *sex designations.*

Attendance at Summer Academy had opposing effects on intention to major in STEM for male and female Scholars. Male Scholars were **more** likely to intend to major in STEM the more sessions of Summer Academy they attended, while female Scholars were **less** likely to have an intended STEM major (Table 28):

Table 28: Prevalence of Intended STEM Major, by Sex

Gender	# SA Cohorts	% Scholars with Intended non-STEM Major	% Scholars Intended STEM Major
Female	No Summer Academy	46.49%	53.51%
Female	1 Session	52.13%	47.87%
Female	2 Sessions	63.0%	37.0%
Male	No Summer Academy	57.4%	42.6%
Male	1 Session	56.8%	43.2%
Male	2 Sessions	26.7%	73.3%

We observe the same pattern in major upon graduation (Table 29):

Table 29: Prevalence of STEM Major upon Graduation, by Sex

Gender	# SA Cohorts	Graduated non-STEM Major	Graduated STEM Major
Female	No Summer Academy	62.3%	37.7%
Female	1 Session	66.0%	34.0%
Female	2 Sessions	74.1%	25.9%
Male	No Summer Academy	62.7%	37.3%
Male	1 Session	54.05%	45.95%
Male	2 Sessions	40.0%	60.0%

Table 30 considers **only those Scholars who have completed their degree and who intended to major in STEM**. For Scholars who intended to major in STEM, the **rate of persistence** for female Scholars who had attended two sessions of Summer Academy was comparable to that of their male counterparts.

Table 30: STEM Persistence, by # SA and Sex

# SA Cohorts	Gender	Dropped STEM	Persisted in STEM	% Persisted in STEM
No Summer Academy	Female	25	36	59.0%
No Summer Academy	Male	6	23	79.3%
1 Session	Female	19	26	57.8%
1 Session	Male	3	13	81.2%
2 Sessions	Female	4	6	60.0%
2 Sessions	Male	4	7	63.6%

This pattern merits further investigation: it is possible that the reason for this leveled persistence is that female Scholars are disproportionately deterred from intending to major in STEM, and so those that remain are predisposed to be more perseverant.

4.8 Impact of the Chemistry Elective

From 2014-2018, an optional Chemistry elective was offered during Summer Academy. On average, roughly 17.5% of Scholars in each cohort who attended Summer Academy opted into this elective (a total of 74 Scholars over five years, Table 31).

Table 31: Proportion of SA-attending Scholars in Chemistry Elective

SA Status	2014	2015	2016	2017	2018
Took SA Chemistry	14.7%	25.9%	15.4%	17.3%	13.2%
SA w/o Chemistry	85.3%	74.1%	84.6%	82.7%	86.8%

A total of 247 unique Scholars took a total of 518 Chemistry courses during their Freshman year, earning an average course GPA of 2.74, with a pass rate of 94.2% and with 44.8% of Scholars earning a B or higher. Of these Scholars, 51 had taken the Chemistry elective during Summer Academy, 139 attended Summer Academy but did not take the Chemistry elective, and 97 did not attend Summer Academy. Controlling for differences in academic preparedness (using SAT Math score as a proxy), there appears to be **no significant relationship between Scholars' performance in those courses and whether or not they were exposed to Chemistry during Summer Academy** (Figure 5).

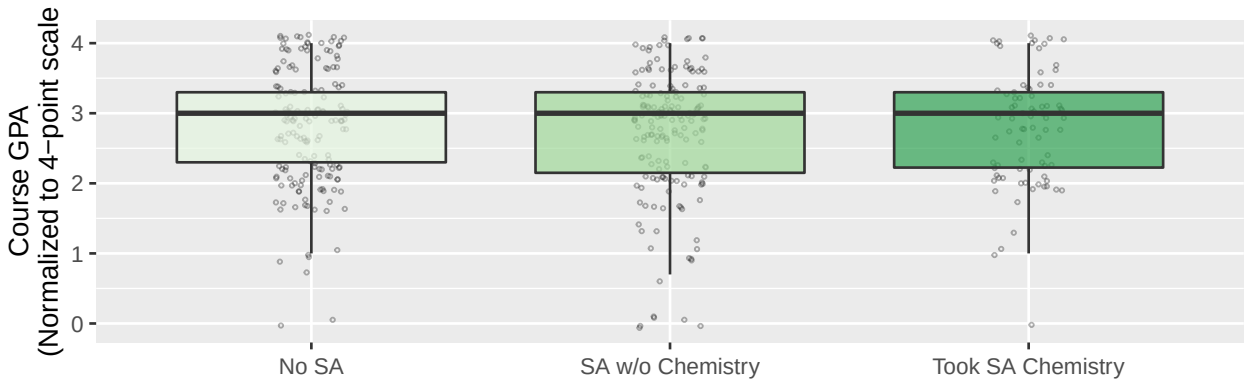

Fig. 5: Average GPA in Freshman Chemistry Courses

However, Scholars who opted into the Chemistry elective during Summer Academy were **2.7 times as likely to take Chemistry during their Freshman year** than either those who did not attend Summer Academy or those who attended Summer Academy, but opted out of the Chemistry Elective (Table 32).

Table 32: Performance of Scholars taking Freshman Chemistry

SA Status	Scholars taking Chemistry Freshman Year	Avg. # Courses per Scholar	Pass Rate	Earn B or above	Earn B+ or above	Earn A- or above
No SA	84 / 370 = 22.7%	2.4	92.9%	46.5%	27.3%	20.2%
SA w/o Chemistry	117 / 519 = 22.5%	1.9	88.3%	43.7%	24.8%	15.8%
Took SA Chemistry	46 / 74 = 62.2%	2.1	90.8%	43.9%	27.6%	15.3%

Note: the latter comparison is likely subject to some selection bias: Scholars attending Summer Academy who were planning to take a Chemistry course in college may have been more likely to opt into the Chemistry elective. We not to have sufficient data to support or refute this hypothesis.

Scholars who took the Chemistry elective during Summer Academy were **twice as likely to have an Intended Major in Chemistry** as Scholars who did not attend Summer Academy, and **8.5 times as likely** as those who attend Summer Academy but did not take the Chemistry elective (Table 33). *Note: as before, this latter comparison is likely subject to selection bias.*

Table 33: Prevalence of Intended Chemistry Major, by SA Status

SA Status	Intend to Major in Chemistry	Other Major
No SA	3.2%	96.8%
SA w/o Chemistry	0.8%	99.2%
Took SA Chemistry	6.8%	93.2%

Scholars who took the Chemistry elective during Summer Academy are **4.3 times as likely to have a Current Major in Chemistry** as Scholars who did not attend Summer Academy, and **7.3 times as likely** as those who attended Summer Academy but did not take the Chemistry elective (Table 34). *Note: as before, this latter comparison is likely subject to selection bias.*

Table 34: Prevalence of Current Chemistry Major, by SA Status

SA Status	Current Major in Chemistry	Other Major
No SA	1.6%	98.4%
SA w/o Chemistry	1.7%	98.3%
Took SA Chemistry	9.5%	90.5%

4.9 Impact of the Computer Science Elective

Beginning in 2016, an optional Computer Science Elective was offered during Summer Academy. On average, roughly 18.1% of Scholars in each cohort (a total of 49 Scholars over two years, Table 35) opted into this elective. In 2019, all second session Scholars were required to take Computer Science.

Table 35: Proportion of SA-attending Scholars in CS Elective

SA Status	2016	2017	2018	2019
SA w/o CS	87.9%	81.7%	74.7%	100%
Took SA CS	12.1%	18.3%	25.3%	–

A total of 138 unique Scholars from the 2016-2019 cohorts took a Computer Science course during their Freshman year, earning an average course GPA of 2.89, with a pass rate of 92.2% and with 51.1% of Scholars earning a B or higher. Of these Scholars, 23 took the Computer Science elective during Summer Academy, 78 attended Summer Academy but did not take the Computer Science elective, and 37 did not attend Summer Academy. Controlling for differences in academic preparedness (using SAT Group as a proxy), there appears to be **no significant relationship between Scholars' performance in those courses and whether or not they were exposed to Computer Science during Summer Academy** (Figure 6).

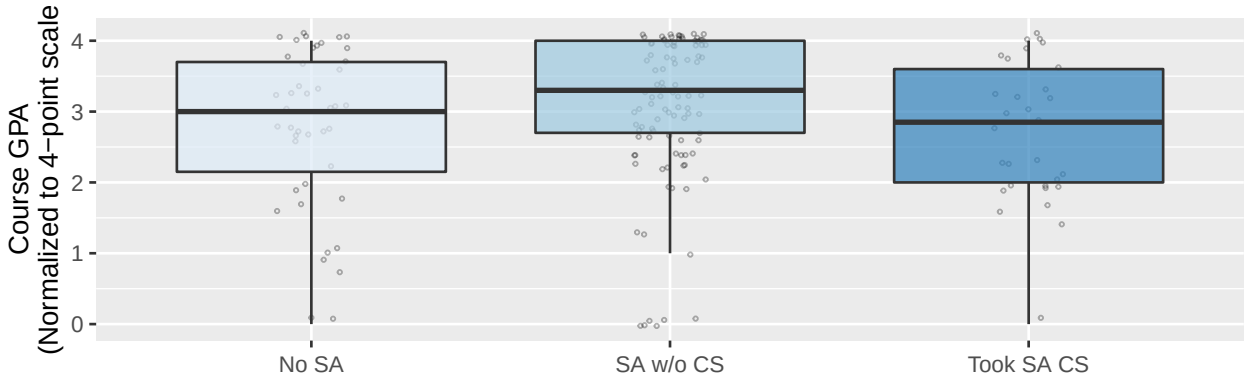

Fig. 6: Average GPA in Freshman Computer Science Courses

As with Chemistry, Scholars who opted into the Computer Science elective during Summer Academy were nearly **3 times as likely to take a Computer Science course during their Freshman year** than those who attended Summer Academy, but opted out of the CS Elective, and **4.7 times as likely** as those who did not attend Summer Academy at all (Table 36).

Table 36: Performance of Scholars taking CS as a Freshman

SA Status	Scholars taking CS Freshman Year	Avg. # Courses per Scholar	Pass Rate	Earn B or Higher	Earn B+ or Higher	Earn A- or Higher
No SA	37 / 371 = 10.0%	1.6	86.9%	45.9%	39.3%	27.9%
SA w/o CS	78 / 543 = 14.4%	1.5	90.0%	55.8%	45.0%	35.8%
Took SA CS	23 / 49 = 46.9%	1.7	92.1%	44.7%	36.8%	23.7%

Scholars who took the Computer Science elective during Summer Academy were **2.5 as likely to have an Intended Major in Computer Science** as Scholars who did not attend Summer Academy, and **four times as likely** as those who attend Summer Academy but did not take the Computer Science elective (Table 37). *Note: the CS elective was mandatory for the 2018 cohort, and so there is less reason to suspect selection bias.*

Table 37: Prevalence of Intended CS Major, by SA Status

SA Status	Intend to Major in CSC	Other Major
No SA	5.8%	94.2%
SA w/o CS	3.6%	96.4%
Took SA CS	14.3%	85.7%

Scholars who took the Computer Science elective during Summer Academy were **8.4 times as likely to have a Current Major in Computer Science** as Scholars who did not attend Summer Academy, and **4.5 times as likely** as those who attended Summer Academy but did not take the Computer Science elective (Table 38). *Note: no scholars who have taken the Computer Science elective have yet graduated, so we report only on Current Major and not Major Upon Graduation. We restrict our analysis to those Scholars who have completed at least one year of college coursework.*

Table 38: Prevalence of Current CS Major, by SA Status

SA Status	Current Major in CSC	Other Major
No SA	2.9%	97.1%
SA w/o CS	5.9%	94.1%
Took SA CS	22.4%	77.6%

Scholars who took the Computer Science elective are also taking advanced computer science coursework (CS2 and beyond) at a greater rate than those who did not attend Summer Academy: **they are 12.8 times more likely to take CS2 / Data Structures during their Freshman year** than a student who did not attend Summer Academy, and **6 times more likely** to do so than a student who attended Summer Academy but did not opt into the Computer Science elective (Table 39).

Table 39: Performance of Scholars taking CS as a Freshman

CS Course Level	SA Status	Scholars taking CS Freshman Year	Pass Rate	Earn B+ or Higher
CS1	No SA	31 / 371 = 8.4%	95.1% 95% CI = [82.2%, 99.2%]	46.3% 95% CI = [31.0%, 62.4%]
CS1	SA w/o CS	53 / 543 = 9.8%	82.3% 95% CI = [70.1%, 90.4%]	50.0% 95% CI = [37.9%, 62.1%]
CS1	Took SA CS	16 / 49 = 32.7%	90.5% 95% CI = [68.2%, 98.3%]	47.6% 95% CI = [26.4%, 69.7%]
CS2	No SA	3 / 371 = 0.8%	100.0% 95% CI = [31.0%, 100.0%]	66.7% 95% CI = [12.5%, 98.2%]
CS2	SA w/o CS	9 / 543 = 1.7%	100.0% 95% CI = [67.9%, 100.0%]	54.5% 95% CI = [24.6%, 81.9%]

CS Course Level	SA Status	Scholars taking CS Freshman Year	Pass Rate	Earn B+ or Higher
CS2	Took SA CS	5 / 49 = 10.2%	100.0% 95% CI = [46.3%, 100.0%]	40.0% 95% CI = [7.3%, 83.0%]
CS Elective	No SA	2 / 371 = 0.5%	50.0% 95% CI = [15.0%, 85.0%]	50.0% 95% CI = [15.0%, 85.0%]
CS Elective	SA w/o CS	14 / 543 = 2.6%	100.0% 95% CI = [80.8%, 100.0%]	76.2% 95% CI = [52.5%, 90.9%]
CS Elective	Took SA CS	4 / 49 = 8.2%	100.0% 95% CI = [39.6%, 100.0%]	75.0% 95% CI = [21.9%, 98.7%]

4.10 Impact on College Access

In 2018-2019, Summer Academy transitioned from a day program to a residential model, beginning with the Scholars at the Amherst site in 2018 (approximately half of the incoming Scholars in the 2019 cohort) and moving to a fully-residential progranm at both sites in 2019. The decision to host the residential pilot at Amherst College was due in part to a perceieved benefit to exposing Scholars to a collegiate environment that was different from the larger city universities toward which Scholars tended to gravitate. It was hypothesized that this inclination might be in part an issue of of awareness, and that this exposure might in turn encourage Scholars to apply to schools in this class: small, rural, elite institutions.

Table 40 compares the Top-enrolled institutions for Scholars who participated in a non-residential Summer Academy with those who attended the residential pilot.

Table 40: Top Institutions by Enrollment for Scholars with non-Residential vs. Residentail SA as a Junior (2018-2019 Cohorts only)

SA Model	Institution	# Scholars Attending
Non-Residential	UC Los Angeles	11
Non-Residential	UC Irvine	8
Non-Residential	UC Berkeley	5
Non-Residential	UC San Diego	5
Non-Residential	California State Polytechnic University, Pomona	4
Non-Residential	University of Southern California	4
Non-Residential	Other Institutions	57
Residential	Amherst College	4
Residential	Dartmouth College	3
Residential	Duke University	3
Residential	Harvard University	3
Residential	Rice University	3
Residential	Stanford University	3
Residential	Other Institutions	31

According to SCS Noonan Scholars, rising high school seniors who were part of the residential Summer Academy also had many more college admissions workshops, opportunities to meet with their College Access coach one-on-one, and participated in 6 or more visits to Top-100 colleges. In addition, they left Summer Academy with a list of the colleges to which they planned to apply, a completed draft of their college application essay, and their common application completed.

Table 41 compares the rate at which Scholars with non-residential Summer Academy enrolled in top-ranked institutions with those who attended the residential model.

Table 41: Scholars Attending Top Schools, Residential vs. non-Residential SA

Group	% attending Ivy-Plus School	% attending Top-50 School	% attending Top-100 School	% attending Lower-Ranked School	% missing
Non-Residential SA as a Junior	10.6%	54.3%	83.0%	16.0%	1.06%
Residential SA as a Junior	34.0%	76.0%	92.0%	8.00%	0%

The difference is striking. In particular, Scholars who attended the residential model:

- Enrolled in an Ivy-Plus institution **3.2 times as often** than those who attended the non-residential model.
- Enrolled in a Top-50 ranked institution **1.4 times as often**.
- Enrolled in a Top-100 ranked institution **1.1 times as often**.

While we do not have sufficient data to assert that the shift in model is responsible for these changes, we can rule out several potential confounding factors. Scholars in both models (2018 and 2019 cohorts):

- Had comparable SAT Percentiles (83.50 $\pm$ 10.89 for non-residential, 86.27 $\pm$ 10.43 for residential)
- Had comparable High School GPAs (3.80 $\pm$ 0.18 for non-residential, 3.87 $\pm$ 0.16 for residential)
- Had comparable income levels (134.27%FPL $\pm$ 76.21% for non-residential, 141.68% $\pm$ 78.03% for residential)

However, Scholars participating in the residential program were recruited from a national pool, which would likely have influenced their awareness of a larger variety of postsecondary institutions. It will be interesting to continue to monitor the influence of the residential model in future cohorts.

5 Recommendations and Future Directions

The preceeding analysis has demonstrated that on average, the Summer Academy program has a significant positive impact on participating Scholars' academic performance. It is important to note, however, that this is just one factor in the complex narrative of Scholar's college experience. In order to achieve the program's objectives, we must look deeply at the ways in which Scholars may not benefit equally from what the program has to offer, and to collect additional data in service of that investigation.

5.1 The Role of Prior Preparation

We have found in many of the previous models that a Scholar's prior preparation (as evidenced by their performance on SATs, e.g.) plays an important role in predicting their academic success in college. If we control for this prior preparation, there is nonetheless a clear relationship both between Scholars' academic performance upon graduation and their participation in Summer Academy: those who attend one session of Summer Academy have an average gain of 0.058 on their GPA upon graduation ($p < 0.00001$), and those

who attend two sessions of Summer Academy have an average gain of 0.197 on their GPA upon graduation ($p < 0.00001$).

However, if we fit a natural spline (a variation of linear regression that allows for flexibility at points in the line there there is a "shift" in the relationship between the predictors and the response, Figure 7), we observe that SAT scores appear to have a very different relationship with GPA after around the 85th percentile:

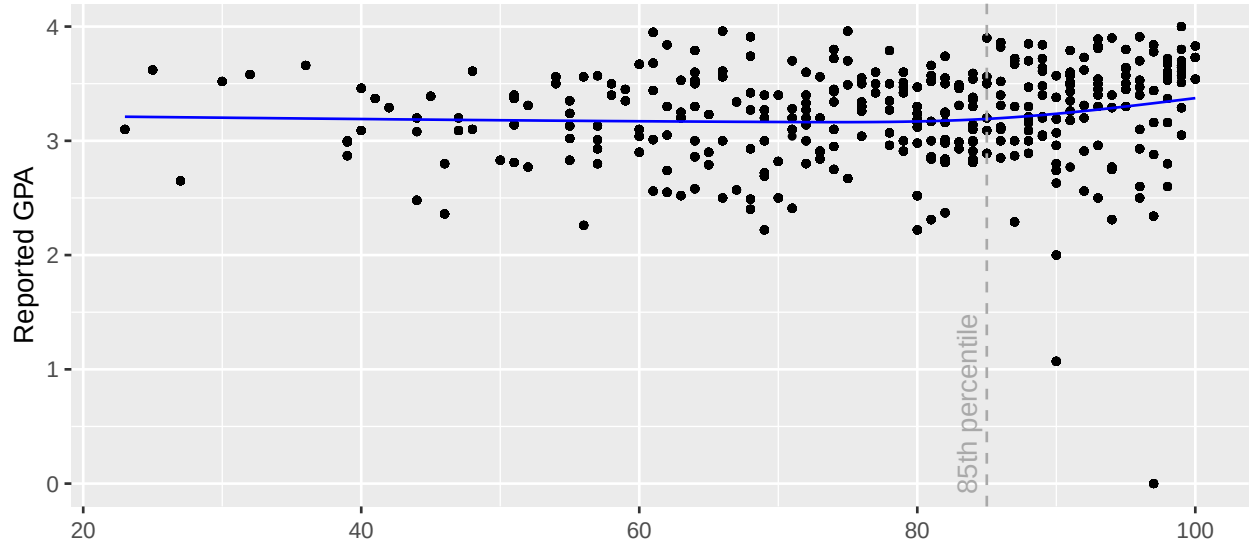

Fig. 7 Natural Spline of GPA by SAT Percentile

Roughly **one third of all Scholars** fall above this range (Figure 8):

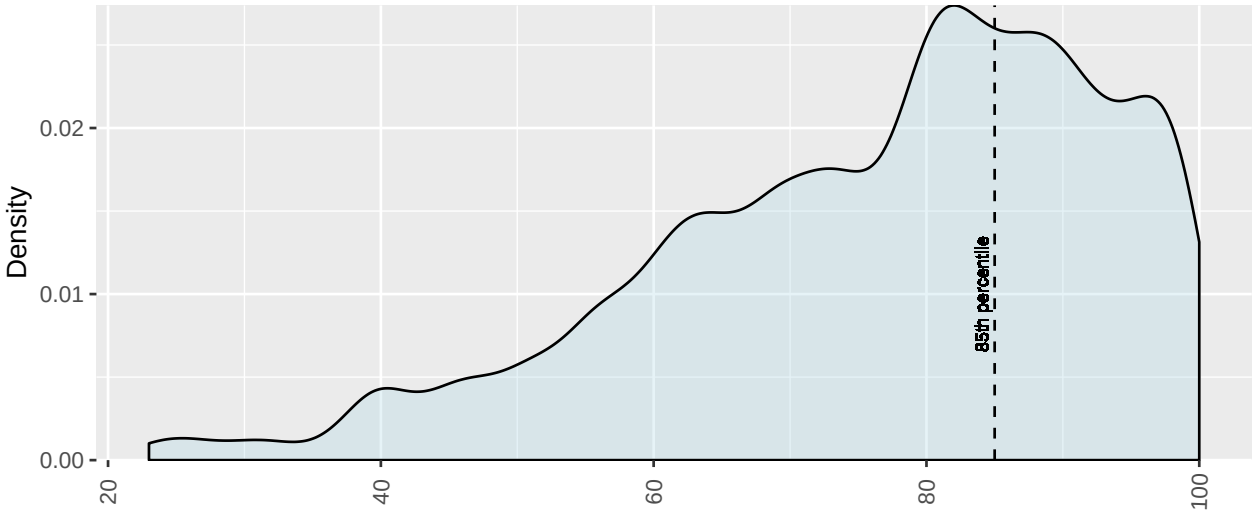

Fig. 8 Density of SAT Percentile

If we consider only those Scholars whose SAT Scores were **within the 75th-85th percentile**, the data tells a very different story:

- For Scholars with an **SAT score within the 75th-85th percentile**, we would expect to see **an average increase of 0.092** in their overall GPA upon graduation for those who attend one session of Summer Academy (more than **1.5 times as much** as the overall collection of Scholars who attend one session of Summer Academy, $p < 0.0001$).
- For those who attend two sessions of Summer Academy, we would still expect to see **an average**

increase of 0.179, comparable to that of the overall collection who attend a second session ($p < 0.01$).

This suggests that Scholars in this middle group are the ones that benefit most significantly from Summer Academy. However, average SAT Scores of admitted Scholars have been steadily increasing (and the range of scores decreasing) since 2016. This suggests the need for a reassessment of recruitment and admittance criteria for the program.

5.2 Institutional Differences

The following example has insufficient sample size to merit statistical validation, but serves instead as food for thought. Consider the following two groups of institutions. The average GPA for Scholars from the 2012-2018 attending instiutions in Table 42: Group A cohorts is 3.25, and the average GPA for Scholars from the same cohorts attending instiutions in Table 43: Group B is 3.23.

Table 42: Group A

Institution	Avg. GPA (No SA)	Avg. GPA (Attended SA)
Brown University	3.292	3.512
Franklin and Marshall College	3.116	3.413
Princeton University	3.058	3.330
University of Southern California	3.055	3.336

Table 43: Group B

Institution	Avg. GPA (No SA)	Avg. GPA (Attended SA)
Dartmouth College	3.583	3.257
Loyola Marymount University	3.592	3.228
University of Pennsylvania	3.450	2.598
Williams College	3.378	3.006

Observe that for instiutions in Group A, the average GPA for Scholars who attended Summer Academy is at a minimum 0.2 higher than for those who did not, and that for instiutions in Group B the opposite is true. Is this simply a numerical anomaly, or is there something setting these two groups apart that is not captured in the presently-collected data?

Recommendation 1: Establish Metrics for Post-Collegiate Success

The stated mission of SCS Noonan Scholars is "to help high-achieving low-income underrepresented students get into and graduate from top colleges **equipped to achieve their full career potential**." In service of this mission, it is critically important to understand not only the impact of the program in the short term, but whether or not Scholars are in fact able to reach their full career potential. Of the 355 Scholar Alumni in the dataset, 313 are presently missing values in both the `6 Months Post College: Employment Status` and `6 Months Post College: Graduate School` fields. In order to understand the longer-term impact of the program on Scholar success, we recommend that SCS Noonan Scholars articulate clear, measurable goals for Scholars' post-undergraduate success and implement a strategy to track progress toward those goals.

Recommendation 2: Report Summer Academy Course Selection

Variation in content and teaching style are not captured in the current data, nor are Scholar's choice between a second course in writing or a second course in mathematics for those who attend a second session of Summer Academy. This limits the analysis to a coarse `Attended` / `Did Not Attend` level of detail which may mask many of the more subtle influences these decisions have on the relationship between Scholars' experiences at Summer Academy and their collegiate success. Should the organization decide to continue to pursue quantitative metrics in, evaluating its efficacy, it is our recommendation that SCS Noonan Scholars formulate a more rigorous data collection strategy and experimental methodology in consultation with a statistician or data scientist.

Recommendation 3: Document Summer Academy Programming and Mentoring

In addition to their experiences in the classroom, Summer Academy provides a unique opportunity for Scholars to develop critical competencies regarding self-advocacy, time management skills, constructive dialogue with peers, and engagement with faculty. This capacity has only been increased since the program's shift toward a residential Summer Academy beginning in 2018. In addition, the program has an impressive mentorship network (both traditional and peer) that connect Scholars to the community supports that are essential for their success in college. Despite the importance of the work being done in these areas through SCS Noonan Scholars, at present it appears that data collection on the programming and ongoing mentorship may be insufficient. As such, many of the program's most powerful mechanisms for scaffolding Scholar success remain undocumented, and so the effectiveness of these specific approaches is impossible to assess. We recommend that SCS Noonan Scholars consider establishing a protocol for tracking which Scholars are exposed to which programming, and develop a regular schedule for evaluating the impact of the specific interventions that are being employed.

Appendix I: Details of the Scholar Metadata Dataset {-}

AI.1 Demographic Information

The first 12 fields in the Scholar Metadata dataset contain identifiers and demographic information about each scholar.

Field Name	Description
`Scholar ID`	a 15-digit unique identifier for each Scholar
`Gender`	one of (`Male`, `Female`, `Non-Binary`)
`Black or African American`	1 if Scholar identifies as Black or African American, 0 otherwise
`Hispanic or Latinx`	1 if Scholar identifies as Hispanic or Latinx, 0 otherwise
`Native Hawaiian or Pacific Islander`	1 if Scholar identifies as Native Hawaiian or Pacific Islander, 0 otherwise
`Asian`	1 if Scholar identifies as Asian, 0 otherwise
`American Indian or Alaska Native`	1 if Scholar identifies as American Indian or Alaska Native, 0 otherwise
`White`	1 if Scholar identifies as White, 0 otherwise
`Family Income`	annual household income in $USD for Scholar's family of origin
`Family Size`	number of individuals in Scholar's family of origin
`Federal Poverty Level Percentage`	% above or below the 2018 US Federal Poverty Level for Scholar's family of origin
`First Generation College Student`	1 if Scholar identifies as a First Generation College Student, 0 otherwise

AI.2 High School and Standardized Testing Information

The next 8 fields in the dataset contain information about each Scholar's high school experience, as well as their performance on the SATs.

Field Name	Description
`High School`	a character string containing the name of the Scholar's high school
`High School Graduation Year`	a value from 2012-2020 representing the year in which the Scholar graduated from high school
`HS Unweighted GPA`	a value from 0-4.3 representing the Scholar's unweighted high school GPA

Field Name	Description
	Note: though GPA is ranked on a 0-4.0 scale, the inclusion of AP coursework can result in an unweighted high school GPA > 4.0.
`Class Rank`	the Scholar's rank in their high school class
`Class Size`	the total number of students in the Scholar's high school class
`SAT Math`	a value from 200-800 representing the Scholar's SAT Math score
`SAT Critical Reading`	a value from 200-800 representing the Scholar's SAT Critical Reading score
`SAT Total`	a value from 400-2400 representing the Scholar's Total SAT score
	Note: from 2011 to 2015, the reference range for the SATs was 600-2400 due to the inclusion of the SAT Writing exam. Beginning in 2016, the exam returned to a reference range of 400-1600.

AI.3 Cohort and College Information

The next 16 fields in the dataset contain information about each Scholar's participation in the SCS Noonan Scholars program, their chosen college, major, and their collegiate academic performance to date.

Field Name	Description
`Scholar Status`	one of (`Current Scholar`, `Scholar Alumni`) representing the Scholar's current status
`Scholar Secondary Status`	a character string containing additional information regarding the Scholar's current status
`Last Renewal Date`	the most recent academic semester in which the Scholar renewed their Scholar status
`SA Cohort`	a value from 2012-2020 representing the Scholar's Summer Academy cohort *Note: this field is left blank for Scholars who have not attended SA.*
`# SA Cohorts`	a value from 0-2 representing the number of summers the Scholar has attended Summer Academy
`SA Chemistry`	1 if the Scholar enrolled in the Chemistry elective during Summer academy, 0 otherwise
`SA Computer Science`	1 if the Scholar enrolled in the Computer Science elective during Summer academy, 0 otherwise
`Scholar College`	a character string containing the name of the Scholar's college
`College: Forbes Ranking`	a value from 1-651 representing the 2017 Forbes Magazine ranking of the Scholar's college
`Intended Major`	a character string representing the Scholar's intended major

Field Name	Description
`Intended Major STEM?`	1 if the Scholar's intended major is a STEM discipline, 0 otherwise
`College Graduation Year`	a value from 2015-2023 representing the year in which the Scholar graduated / will graduate from college, appended with `W` if the Scholar is / will be a winter graduate
`# of College Terms`	a value from 0-17 representing the number of college terms that have elapsed since the Scholar began college *Note: this field includes both completed terms and leaves of absence.*
`Current Major`	a character string representing the Scholar's current major
`Current Major STEM?`	1 if the Scholar's current major is a STEM discipline, 0 otherwise
`Reported Total GPA`	a value from 0-4.0 representing the Scholar's most recent self-reported collegiate GPA

AI.4 After-College Information

The final 4 fields in the provided dataset contain information about each Scholar's degree, student loan burden, and post-graduate plans.

Field Name	Description
`College Degree Earned Type`	one of (`B.A.`, `B.S.`, `B.Eng`) represening the type of undergraduate degree earned by the Scholar *Note: this field is left blank for Scholars who have not yet completed their degree.*
`Estimated Student Loans at Graduation`	one of (`No Student Loans`, `Less than 5,000`, `5,000-9,999`, `10,000-19,999`, `20,000-29,999`, `More than 30,000`) representing the Scholar's estimated student loan burden in $USD upon graduation.
`6 Months Post College: Employment Status`	one of (`"Employed, full-time"`, `"Employed, part-time"`, `"Not employed, and not seeking employment"`, `"Not employed, but seeking employment"`, `"Volunteer, service, or gap year program"`)
`6 Months Post College: Graduate School`	one of (`Yes`, `No`, `Eventually`) representing the Scholar's intention to pursue graduate study

AI.5 Calculated and Supplemental Fields

In addition to the provided data, several additional fields were calculated and appended to the original dataset to facilitate analysis.

Field Name	Description
`Family Income per Capita`	`Family Income` / `Family Size`
`# Years of College`	`College Graduation Year` - `HS Graduation Year` *Note: this field includes both completed years and leaves of absence. Scholars graduating in the winter have 0.5 years deducted.*
`# Years to Graduate`	`# Years of College` if Scholar has graduated, otherwise blank
`SAT Group`	a coarser granulation of SAT Percentile, one of (`<50th`, `50th-80th`, `>80th`)
`STEM Persistence`	one of (`Persisted in non-STEM`, `Dropped STEM`, `Added STEM`, `Persisted in STEM`) indicating the relationship between the Scholar's intended and current major category
`SAT Percentile`	a value ranging from 2-100 representing the percentile rank of the Scholar's composite SAT score, as reported by the College Board in the year in which the examination was taken

Appendix II: Details of the Scholar Transcript Dataset

AII.1 Identifiers and Demographic

Field Name	Description
`Scholar ID`	a 15-digit unique identifier for each Scholar *Note: this corresponds to the field of the same name in `Scholar Metadata.csv` and is used as a key to join these datasets.*
`College Year`	the grade level for which the transcript was recorded, one of: (`Freshman`,`Sophomore`,`Junior`,`Senior`,`Super Senior`)
`Transcript Year`	the calendar year in which the transcript was recorded
`Transcript Term`	the academic term in which the transcript was recorded, one of: (`Fall`,`Spring`,`Winter`,`Summer`)
`Transcript 18 ID`	an 18-digit unique identifier for each transcript *Note: transcripts are submitted after each semester; a single Scholar may have multiple transcripts included the dataset.*
`Course 18 ID`	an 18-digit unique identifier for each course attempt taken by a Scholar *Note: these identifiers are unique per Scholar, per course attempt (even if multiple Scholars take the same course at one institution).*

AII.2 Course Topic and Discipline

Field Name	Description
`Course Name`	the common name of the course as it is listed on the transcript
`NCES Course`	the standardized name for the course, from the National Center for Education Statistics
`NCES Major Category`	the top-level standardized category for the course, from the National Center for Education Statistics
`CIP Code and Title`	the standardized code and title for the course using the Classification of Instructional Programs (CIP) taxonomy, from the National Center for Education Statistics
`Math Category`	an internal designation by SCS Noonan Scholars documenting the level of mathematics courses, one of: `A:` All Precalculus Algebra, Trigonometry and Introduction to Calculus `B1:` Single Variable Calculus `B2:` Multivariable Calculus `C:` Intermediate Mathematics beyond Calculus II, 200-Level Mathematics `D:` Advanced Mathematics, 300- to 400-Level Mathematics `E:` Statistics `O:` Other (Math for Non-Science Majors, Quantative Reasoning, etc.) *Note: this field left blank for non-mathematics courses.*

AII.3 Performance

Field Name	Description
`Course GPA (Normalized)`	the Scholar's earned GPA in the course, normalized to a 4-point scale *Note: courses with a grading option of `Pass/Credit` or `Fail/No Credit`, as well as courses from which the Scholar withdrew are listed a 0.*
`Course Grade`	the Scholar's earned letter grade in the course, one of: (`A`, `A-`, `B+`, `B`, `B-`, `C+`, `C`, `C-`, `D+`, `D`, `D-`, `F`, `Pass/Credit`, `Fail/No Credit`, `Withdrawn`)

AII.4 Calculated and Supplemental Fields

In addition to the provided data, the following additional field was calculated and appended to the original dataset to facilitate analysis.

Field Name	Description
`Performance`	`"B+ or above"` if the earned grade is a B+ or higher or `Pass/Credit`, `"B or above"` if the earned grade is a B or higher, `"Below B"` otherwise (calculated field)
`STEM Course?`	1 if the course is in a STEM discipline, 0 otherwise *Note: STEM disciplines include: Physics; Mathematics; Chemistry;*

Field Name	Description
	Computer Science; Biology; Chemistry; Geology; Engineering; Genetics; Statistics; Pre-Med; and variations thereof. This label was manually curated.
`Writing-Intensive?`	1 if the course is in a Writing-Intensive discipline, 0 otherwise *Note: Writing-Intensive disciplines include: Communication; Journalism and Related Programs; English Language and Literature/Letters; Foreign Languages, Literatures, and Linguistics; History; Legal Professions and Studies; and Philosophy and Religious Studies. This label was manually curated.*
`GPA - Freshman Year`	a value from 0-4.0 representing the Scholar's calculated collegiate GPA during their freshman year *Note: this field (and subsequent fields for later years) left blank for Scholars who have not completed the corresponding year.*
`GPA - Sophomore Year`	a value from 0-4.0 representing the Scholar's calculated collegiate GPA during their sophomore year
`GPA - Juinior Year`	a value from 0-4.0 representing the Scholar's calculated collegiate GPA during their junior year
`GPA - Senior Year`	a value from 0-4.0 representing the Scholar's calculated collegiate GPA during their senior year
`GPA - Super Senior`	a value from 0-4.0 representing the Scholar's calculated collegiate GPA during years beyond the 4th year