University Production Functions and the Choice of College Major: Evidence from California

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Abstract

This paper examines how universities produce graduates in different fields. Using data on the University of California system, we show significant sorting into majors based on academic credentials, with science majors at each school having on average stronger credentials than their non-science counterparts. We show that students with relatively weak academic credentials are significantly more likely to leave the sciences and take longer to graduate if they attend one of the top-tier UC schools. This was particularly true for minority students before the passage of Proposition 209, which banned the use of racial preferences in admissions. We show that one of the effects of Proposition 209 was to increase persistence in the sciences through allocating minority students to schools where their credentials were a better match with the school they were attending. We also show that UC schools responded to Proposition 209 in such a way that those with weaker credentials were more likely to graduate.

1 Introduction

The American Community Survey indicates that 72 percent of Science, Technology, Engineering and Math (STEM) jobs are held by Whites, where their overall representation in the U.S. workforce is 68 percent. However, substantial disproportions can be found when considering other racial groups. While Asians are nearly three times as likely as all workers

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to have STEM jobs, only half as many Black or Hispanic workers have this type of occupations relative to their representation in the U.S. workforce. More specifically, Asians account for 14 percent of all STEM workers but only 5 percent of the U.S. workforce; and Blacks and Hispanics each represent six percent of all STEM workers, but 11 percent and 14 percent, respectively of overall employment[1].

The underrepresentation of minorities in the STEM workforce is problematic for many reasons. For example, it could contribute to perpetuate income racial disparities. Arcidiacono (2004) shows that large monetary premiums exist for choosing natural science and business majors even after controlling for selection. In a similar vein, Melguizo and Wolniak (2012) show the economic benefits minority students experience from majoring in a STEM field. Recently, the lack of minority representation in the sciences has become an issue of national interest[2], where many resources have been invested in order to expand education in these fields. For instance, on September 2010, the government announced a goal of recruiting 10,000 STEM teachers over the next two years[3].

While these types of policies can help to overcome current racial disparities, very little is known about the mechanism that determines how college campuses produce graduates in science majors. For example, it has not been examined whether selective institutions show absolute advantage on producing graduates in certain type of fields[4] (independently of the student academic preparation). If this is the case, then increasing minority enrollment in these schools could contribute to reduce current disparities. On the contrary, such absolute advantage may not exist, and college campuses may have heterogeneous comparative advantages on graduating students in the sciences.

In this regard, being able to determine the relative (absolute) strengths of different college campuses, could contribute to redesigning current public policies. For example, attempts to increase minority representation at elite universities through the use of affirmative action may lead to (un)desirable outcomes, if selective institutions are comparatively better (worse) in granting science majors to those students that show relative weaker entering academic credentials.

By making use of a rich database that contains information on applicants, enrollees and

[1]Similar proportions can be found for science and engineering degrees. For example, African Americans had earned 6 percent of the bachelor's degrees in 1996-1997. See Huang et al. (2000).

[2]See National Science Board (2007).

[3]The program "Educate to Innovate"intends to improve STEM education in the United States.

[4]Griffith (2010) constitutes an exception. Basically, she finds that institutional characteristics play a key role in the decision to persist in a STEM major. For example, it is shown that students at selective colleges with large research expenditures relative to total educational expenditures have lower persistence rates in the sciences, particularly minority students.

graduates of the UC system, we estimate campus specific graduation functions in different fields to test for the presence of cross-campus comparative advantages at different points of the student academic distribution. Then, we perform a set of counterfactual simulations showing how graduation rates in science and non-science majors could have changed under different regimes that reshuffle students across UC campuses. Finally, we analyze whether UC campuses adjust their production functions in response to the elimination of affirmative action.

Results indicate significant sorting into majors based on academic credentials, with science majors at each school having on average stronger academic preparation than their non-science counterparts. In addition, students with relatively weak academic credentials are significantly more likely to switch out from the sciences and take longer to graduate if they attend one of the top-tier UC schools. This was particularly exacerbated for minority students before the passage of Proposition 209, which banned the use of racial preferences in admissions. In this regard, one of the effects of Proposition 209 was to increase persistence in the sciences through allocating minority students to schools where their credentials were a better match with the school they were attending. Finally, the evidence indicates that UC schools responded to Proposition 209 by changing their productions so that those with weaker credentials were more likely to graduate.

The rest of the document is organized as follows: section 2 describes the data and presents summary statistics. Section 3 presents the econometric model. Section 4 presents the results of campus graduation production functions in different fields. Section 5 present counterfactual simulations. Section 6 concludes.

2 Data

The data we use were obtained from the University of California Office of the President (UCOP) under a California Public Records Act request. These data contain information on applicants, enrollees and graduates of the UC system. Due to confidentiality concerns, some individual-level information was suppressed. In particular, the UCOP data have the following limitations:[5]

1. The data are aggregated into three year intervals from 1995-2006.

2. The data provide no information on gender, and race is aggregated into four categories: white, Asian, minority, and other

[5]See Antonovics and Sander (2012) for a more detailed discussion of this data set.

3. Academic data, such as SAT scores and high school grade point average (GPA), were only provided as categorical variables, rather than the actual scores and GPAs.

Weighed against these limitations is having access to the universe of students who applied to school in the UC system and also whether they were accepted or rejected at every UC school where they submitted an application. Proposition 209, which banned the use of racial preferences in admissions, went into effect in 1998. Hence, we have three years of data before Proposition 209 and nine years after.

We begin by examining differences in graduation rates and SAT scores by school for both majority and minority students during the period where race-conscious admissions were legal. The first set of rows of Table **??** gives SAT scores by school and race. For majority students, there is clear sorting among the top three schools: Berkeley, UCLA, and San Diego, in that order. The next set of four schools (Davis, Irvine, Santa Barbara, and Santa Cruz) have somewhat similar average SAT scores, with Riverside just a bit lower than these five. For minority students, average SAT scores display the same patterns across schools, though the relationship is flatter here than for majority students, with the gap between Berkeley minority students and Riverside minority students at 178 points, as opposed to 234 points for majority students. SAT scores for minority students are substantially lower than their white counterparts at each school, with average minority SAT scores at each school all being lower than the average SAT score for a majority student at Santa Cruz.

Differences in credentials translate to differences in graduation rates, with the gaps being particularly large at the top schools. Majority students at Berkeley have graduation rates that are almost 18 percentage points higher than minority students at Berkeley, while the gap at Riverside is less than 3 percentage points. Four year graduation rates are even starker, with almost 56% of majority students at Berkeley graduating in four years and the corresponding number for minorities being less than 35%. Gaps also exist across schools, with top schools having both students with stronger credentials and higher graduation rates.

Despite significant differences in SAT scores between majority and minority groups, there is a U-shaped pattern between average SAT scores and share minority. The three most diverse universities are Berkeley, UCLA, and Riverside. A similar U-shaped pattern was found in national data in Arcidiacono, Khan, and Vigdor (2011), suggesting diversity at the top schools comes at the expense of diversity of the middle tier institutions.

Differences in the persistence rates in science majors and the characteristics of those who persist are also large. Table **??** shows average SAT scores and the share of individuals completing a science or non-science major in 5 years by race and initial major. Significant sorting occurs at each school, with those who finish in the sciences having higher average

Table 1: 1995-1997 Average SAT Scores and Graduation Rates by Majority-Minority Status

	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
Majority SAT	1335	1279	1245	1183	1136	1156	1164	1101	1210
Minority SAT	1142	1119	1122	1072	1026	1024	1020	965	1074
Majority-Minority SAT	193	160	123	111	110	132	143	136	136
Majority 5 Year Grad. rate	85.7%	82.7%	78.9%	75.0%	67.3%	70.3%	65.2%	61.0%	74.8%
Minority 5 Year Grad. rate	68.0%	65.6%	65.3%	54.3%	62.4%	59.1%	59.6%	58.4%	62.3%
Majority-Minority 5 Year Grad. rate	17.7%	17.1%	13.6%	20.8%	4.8%	11.2%	5.6%	2.7%	12.4%
Majority 4 Year Grad. rate	55.7%	52.1%	54.3%	38.8%	36.9%	46.5%	43.0%	42.0%	46.7%
Minority 4 Year Grad. rate	34.7%	31.1%	37.5%	22.1%	28.4%	31.6%	36.9%	33.6%	31.7%
Majority-Minority 4 Year Grad. rate	21.0%	21.0%	16.8%	16.8%	8.5%	14.9%	6.1%	8.4%	14.9%
Minority Share	22.1%	25.3%	12.5%	14.7%	13.1%	18.0%	17.5%	25.0%	18.4%

SAT scores than those who do not, regardless of initial major. While within each school SAT scores for majority students who persist in the sciences are between 16 to 41 points higher than those who switch to a non-science major, the differences are much larger for minority students. Within each school, minority students who persist in the sciences have SAT scores between 51 and 105 points higher than those who switch to a non-science major.

The much larger differences in average SAT scores for minority students are indicative of substantial differences in the probability of persisting in the sciences. Majority students whose initial major is in the sciences finish in the sciences over 60% of the time at Berkeley. In contrast, minority students at Berkeley who initial major is in the sciences finish in the sciences only 30.5% of the time. The majority-minority gap in persistence rates shrinks as the university becomes less selective. Switching into the sciences is also much less likely among minority students, with gaps again largest at the top schools. While 14.2% of majority students in the non-sciences switch into the sciences, only 3% of minority students do so.

The low persistence rates in the sciences also translate into higher rates of not finishing for those who initial major is in the sciences. With the exception of Berkeley, majority students whose initial major is in the sciences are less likely to finish in any major than those who majors are not in the sciences, despite higher SAT scores for those who start out in the sciences. The gaps are again much larger for minority students, with those whose initial major is in the sciences being between 5 and 15 percentage points less likely to finish in any major in five years, again despite higher SAT scores.

Table **??** showed that persistence rates in the sciences were higher at the top schools but that these schools also had higher average SAT scores. Similarly, persistence rates were higher for majority students than minority students, but this too may be driven by differences in average SAT scores. We now take a first step towards separating out whether higher persistence rates at top schools are due to better students or due to something top schools are doing differently than the the less-selective schools by breaking out persistence rates by quartiles of the SAT score distribution for those who enrolled in one of the eight UC campuses. Table **??** shows results for minorities, with the similar results for majority students found in the appendix.

Table **??** presents evidence that minority students with low SAT scores would be more likely to persist in the sciences if they attended a less-selective institution. Minority students in the bottom quartile of the SAT score distribution who attend Berkeley graduated in the sciences at a lower rate that similar students at Riverside, despite those in the bottom quartile at Berkeley likely being stronger in other dimensions (high school grades, parental education,

Table 2: 1995-1997 SAT Scores by School, Majority-Minority Status, Initial and Final (5 Year) Major

Group	Initial Major	Final Major		Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside
Majority	Science	Science	SAT	1362	1301	1268	1229	1172	1192	1172	1120
			share	60.6%	51.8%	50.6%	46.3%	35.5%	34.2%	28.6%	31.3%
		Non-Science	SAT	1341	1285	1241	1197	1140	1151	1152	1053
			share	25.2%	28.4%	26.1%	27.4%	29.9%	31.2%	33.6%	24.2%
		Did Not Finish	SAT	1346	1275	1224	1200	1130	1151	1136	1074
			share	14.1%	19.8%	23.3%	26.3%	34.7%	34.5%	37.8%	44.5%
	Non-Science	Science	SAT	1348	1291	1251	1181	1143	1166	1189	1188
			share	14.2%	11.2%	15.9%	13.8%	7.4%	4.1%	6.2%	15.6%
		Non-Science	SAT	1323	1275	1239	1168	1128	1156	1167	1093
			share	71.3%	73.0%	65.1%	62.1%	61.4%	67.9%	59.9%	47.2%
		Did Not Finish	SAT	1297	1246	1239	1148	1121	1145	1163	1091
			share	14.5%	15.8%	19.1%	24.2%	31.3%	28.0%	33.9%	37.2%
Minority	Science	Science	SAT	1275	1179	1178	1180	1111	1094	1073	1035
			share	30.5%	28.4%	31.0%	25.6%	23.8%	25.6%	19.7%	20.0%
		Non-Science	SAT	1170	1128	1108	1105	1044	1026	1019	967
			share	36.1%	32.5%	32.7%	25.6%	36.3%	30.7%	31.8%	27.9%
		Did Not Finish	SAT	1178	1113	1099	1100	1046	1018	1001	968
			share	33.4%	39.1%	36.4%	48.9%	39.9%	43.7%	48.5%	52.1%
	Non-Science	Science	SAT	1222	1189	1163	1103	1132	1150	1108	1065
			share	3.0%	4.9%	5.9%	6.1%	2.7%	3.1%	5.4%	6.4%
		Non-Science	SAT	1136	1132	1156	1048	1058	1067	1049	966
			share	68.5%	69.0%	68.9%	57.3%	65.1%	67.6%	60.8%	54.8%
		Did Not Finish	SAT	1092	1095	1132	1012	1061	1058	1050	966
			share	28.6%	26.0%	25.2%	36.6%	32.2%	29.4%	33.8%	38.9%

etc.) than those in the bottom quartile at Riverside.[6] Note that the total graduation rate for initial science majors in the bottom quartile is actually higher at Berkeley and Riverside. The primary difference is that at Berkeley many of the students switch to non-science majors. Indeed, initial science majors in the bottom quartile at Berkeley are close to four times as likely to graduate in the non-sciences than in the sciences.

The results are different for minorities in the top quartiles, with those attending Berkeley graduate at a higher rate in the sciences than those at Riverside. This is suggestive that matching may be important–at least in the sciences–, with top schools being particularly advantageous for those at the top of preparation distribution and less selective schools being more advantageous for those further down the preparation distribution. But beyond differences across schools, the reality is that those in the bottom quartiles of the SAT score distribution have very low persistence rates in the sciences.

Table **??** also reenforces the point that an initial major in the sciences makes graduation in any field in five years less likely, particularly for minorities in the bottom quartile of the SAT score distribution. Overall, minorities in the bottom quartile with an initial major in science have graduation probabilities that are over eight percentage points lower than their non-science counterparts. The similar gap for those in the top quartile is five and a half percentage points.

The patterns of persistence in the science and probabilities of graduating in any field are even more striking if we instead examine four year graduation rates. Table **??** repeats the analysis of Table **??**, but this time examines four year graduation rates. The probability that a minority in the bottom quartile of the SAT score distribution who is initially interested in the sciences graduates in the sciences in four years at Berkeley is astonishingly low at 3.1%– less than a third of the similar four-year rate for Riverside. This again occurs despite those Berkeley having stronger credentials on other dimensions. In general, those at the bottom of the SAT score distribution see significantly higher four-year graduation rates in the sciences at lower tier institutions while there is little relationship between four-year graduation rates and the selectivity of the institution for those at the top of the SAT score distribution.

[6]One may be concerned that the bottom quartile of the total SAT score distribution would not be well represented at Berkeley. However, minority students at Berkeley are spread fairly evenly across the SAT quartiles.

Table 3: Minority 5 Year Graduation Rates by School, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
		Probability of Graduation in Science								
Science	Q1	12.4%	17.3%	20.1%	15.5%	18.4%	19.2%	16.0%	16.9%	17.4%
	Q2	17.5%	29.8%	31.6%	24.9%	27.0%	29.3%	26.0%	30.0%	27.5%
	Q3	45.1%	38.3%	38.7%	41.8%	30.0%	46.3%	20.8%	22.2%	39.2%
	Q4	46.2%	42.9%	56.3%	43.4%	50.0%	50.0%	33.3%	33.3%	46.3%
Non-Science	Q1	3.2%	2.4%	3.3%	4.4%	4.0%	0.9%	4.4%	4.2%	3.1%
	Q2	3.2%	4.6%	7.8%	5.4%	2.9%	2.1%	1.7%	9.3%	4.3%
	Q3	4.3%	6.2%	5.6%	14.3%	7.5%	4.8%	5.5%	15.4%	6.3%
	Q4	10.8%	10.6%	10.8%	17.0%	16.7%	4.9%	6.3%	33.3%	11.1%
		Probability of Graduation in Non-Science								
Science	Q1	46.4%	35.0%	36.3%	27.1%	41.4%	32.3%	31.3%	29.2%	34.4%
	Q2	47.6%	32.4%	33.5%	31.0%	31.4%	30.7%	34.0%	24.0%	33.5%
	Q3	28.7%	29.9%	29.3%	15.2%	28.0%	22.0%	29.2%	33.3%	26.7%
	Q4	21.4%	28.6%	20.8%	15.1%	26.9%	25.0%	33.3%	0.0%	22.6%
Non-Science	Q1	63.2%	58.1%	54.0%	46.5%	60.4%	57.2%	56.5%	56.5%	57.0%
	Q2	64.3%	66.1%	62.7%	54.3%	56.6%	61.2%	60.6%	51.9%	61.9%
	Q3	66.7%	67.4%	72.2%	57.1%	65.0%	54.8%	56.2%	46.2%	64.4%
	Q4	63.6%	65.5%	59.5%	51.1%	58.3%	68.3%	71.9%	55.6%	63.2%
		Probability of Graduation Total								
Science	Q1	58.8%	52.3%	56.4%	42.5%	59.8%	51.5%	47.2%	46.1%	51.8%
	Q2	65.0%	62.2%	65.1%	55.8%	58.4%	60.0%	60.0%	54.0%	60.9%
	Q3	73.8%	68.2%	68.0%	57.0%	58.0%	68.3%	50.0%	55.6%	65.9%
	Q4	67.5%	71.4%	77.1%	58.5%	76.9%	75.0%	66.7%	33.3%	68.8%
Non-Science	Q1	66.3%	60.6%	57.4%	50.9%	64.4%	58.1%	61.0%	60.7%	60.1%
	Q2	67.4%	70.7%	70.5%	59.7%	59.6%	63.3%	62.2%	61.1%	66.3%
	Q3	70.9%	73.6%	77.8%	71.4%	72.5%	59.5%	61.6%	61.5%	70.6%
	Q4	74.4%	76.1%	70.3%	68.1%	75.0%	73.2%	78.1%	88.9%	74.3%

Table 4: Minority 4 Year Graduation Rates by School, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
		Probability of Graduation in Science								
Science	Q1	3.1%	3.5%	7.3%	2.9%	5.8%	7.9%	8.3%	10.7%	6.2%
	Q2	7.0%	9.2%	18.1%	6.6%	11.0%	14.0%	14.0%	16.0%	11.3%
	Q3	20.5%	15.6%	20.0%	22.8%	16.0%	29.3%	16.7%	11.1%	19.3%
	Q4	26.5%	22.2%	25.0%	24.5%	30.8%	33.3%	33.3%	33.3%	26.1%
Non-Science	Q1	0.3%	0.5%	1.4%	0.9%	0.2%	0.1%	2.3%	2.9%	1.0%
	Q2	1.3%	1.3%	2.1%	1.4%	0.7%	1.1%	0.6%	6.2%	1.6%
	Q3	2.3%	2.3%	4.4%	2.4%	5.0%	1.2%	1.4%	15.4%	2.8%
	Q4	6.3%	5.3%	10.8%	14.9%	16.7%	4.9%	6.3%	33.3%	7.9%
		Probability of Graduation in Non-Science								
Science	Q1	13.4%	9.5%	14.1%	9.1%	12.5%	10.2%	15.8%	14.1%	12.1%
	Q2	15.0%	11.9%	14.9%	10.3%	14.3%	9.5%	15.9%	11.6%	13.6%
	Q3	14.1%	12.4%	14.1%	9.8%	14.3%	8.2%	15.0%	9.0%	11.7%
	Q4	11.9%	12.2%	12.6%	8.5%	13.5%	6.5%	13.6%	6.3%	10.1%
Non-Science	Q1	27.4%	22.0%	31.9%	20.9%	29.9%	32.2%	39.5%	33.7%	29.4%
	Q2	34.8%	31.4%	39.4%	28.7%	38.7%	39.1%	45.2%	36.6%	35.7%
	Q3	39.3%	38.1%	43.8%	33.7%	44.4%	43.1%	48.4%	35.7%	40.5%
	Q4	40.7%	42.1%	45.5%	35.3%	47.7%	44.6%	49.5%	31.4%	40.7%
		Probability of Graduation Total								
Science	Q1	16.5%	13.0%	21.3%	12.0%	18.3%	18.1%	24.2%	24.7%	18.3%
	Q2	22.0%	21.1%	33.1%	16.9%	25.3%	23.5%	29.9%	27.6%	24.9%
	Q3	34.6%	28.0%	34.1%	32.5%	30.3%	37.5%	31.7%	20.1%	31.0%
	Q4	38.4%	34.4%	37.6%	33.1%	44.3%	39.9%	46.9%	39.7%	36.2%
Non-Science	Q1	27.7%	22.5%	33.3%	21.7%	30.1%	32.3%	41.8%	36.6%	30.4%
	Q2	36.2%	32.8%	41.5%	30.1%	39.4%	40.1%	45.8%	42.8%	37.3%
	Q3	41.6%	40.4%	48.2%	36.0%	49.4%	44.3%	49.8%	51.1%	43.2%
	Q4	46.9%	47.5%	56.3%	50.2%	64.3%	49.5%	55.8%	64.7%	48.6%

3 Model

We now turn to the modeling of college graduation in particular fields, treating finishing in a particular time period in a particular major as a choice. We assume that the various abilities of the student can be characterized by a set of characteristics X_i. These characteristics are then rewarded in majors differently. The academic index for major j, AI_j, is then given by:

$$AI_{ij} = X_i \beta_j \tag{1}$$

where β_j allows for the weights on the various abilities to vary by major.

The payoff an individual receives from majoring in j at school k is a function of the academic indexes as well as whether the student was initially interested in the major. We specify the utility function as:

$$\begin{aligned} U_{ijk} &= u_{ijk} + \epsilon_{ijk} \\ &= \alpha_{0jk} + AI_{ij}\alpha_{1jk} + C_{ijk} + \epsilon_{ijk} \end{aligned} \tag{2}$$

where α_{0jk} represents the baseline payoff majoring in k at school j, α_{1jk} gives how the returns to the academic index in major j vary by school, C_{ijk} represents a switching cost that individuals pay if they are making a major choice that is not the same as the major they entered with, and ϵ_{ijk} is an unobserved preference term.

We specify the cost of switching majors to depend on the major, the individual's academic index, a set of characteristics designed to measure, for example, parental support, Z_i, and allow switching costs to differ by school. C_{ijk} is then specified as:

$$C_{ijk} = \begin{cases} AI_{ij}\alpha_{2j} + Z_i\alpha_3 + \alpha_{4k} & \text{if initial major} \neq j \\ 0 & \text{if initial major} = j \end{cases} \tag{3}$$

We then normalize the utility of not finishing to zero.

We specify the error structure such that it has a nested logic form, allowing the errors to be correlated among the two schooling options. The probability of choosing one of the schooling options when X and Z are observed but not ϵ then follows:

$$p_{ijk} = \frac{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho-1} \exp\left(\frac{u_{ijk}}{\rho}\right)}{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho} + 1} \tag{4}$$

with the corresponding probability of choosing not to graduate given by:

$$p_{i0k} = \frac{1}{\left(\sum_{j'} \exp\left(\frac{u_{ij'k}}{\rho}\right)\right)^{\rho} + 1} \tag{5}$$

We then estimate separate nested logit models for minority and majority students, as well as separate models for four and five year graduation rates.

4 Results

Estimates of the key parameters for 5 year graduation rates are given in Table **??**. The first set of rows give some of the parameters governing the academic index for science and non-science majors. There are significant asymmetries across the two majors. SAT math is much more important to the science index, while SAT verbal is more important for the non-sciences. High school gpa is important to both indexes but the coefficient in the science index is close to double that of the coefficient in the non-science index for both majority and minority students.

The next set of columns show the importance of institutional fit. Top schools such as Berkeley and UCLA have lower intercepts and steeper slopes relative to other schools. Hence, they have a comparative advantage in graduating those who have high academic indexes. While the general patterns seem to indicate that the coefficients are the same for minority and majority students, that the production functions are the same for majority and minority students fails a likelihood ratio test.

To understand how the productions vary by institution, we use the model estimates to obtain predicted graduation rates for all those who attended a UC school, obtaining both predicted probabilities at the school they attended as well as at all counterfactual UC schools. Table **??** gives predicted graduation probabilities by initial major and SAT quartile for minorities, effectively allowing us to purge the results of Table **??** of selection effects. Since these are averages of all individuals in each of the SAT quartiles, the other observed characteristics will be representative of those found within the SAT quartile.

Lower SAT scores are associated with switching out of the sciences or not finishing at all schools. However, there is a lot of heterogeneity across schools in persistence rates, particularly for the bottom quartile. Students in the bottom quartile see an average persistence rate in the sciences of 11.1% at Berkeley. The corresponding numbers for the bottom three UC schools are all above 20%. The relationship substantially flattens out at higher SAT

Table 5: Nested Logit Coefficients for Choice of Final Major (5 year) for 1995-1997 period

	Majority		Minority	
	Science	Non-Science	Science	Non-Science
	Index Coeffients			
HS gpa	**1.210**	**0.669**	**1.216**	**0.674**
SAT verbal	-0.148	**1.462**	**1.123**	**1.631**
SAT math	**4.175**	**-1.060**	**4.725**	-0.884
	Intercept Coefficients (relative to Berkeley)			
UCLA	-0.485	**-1.561**	0.894	-1.498
San Diego	**1.745**	-0.077	2.802	0.251
Davis	**1.436**	-0.335	0.758	-1.219
Irvine	**1.500**	0.141	2.436	-0.223
Santa Barbara	**2.275**	0.535	2.681	0.584
Santa Cruz	**3.860**	**0.930**	**4.970**	1.291
Riverside	**2.130**	**0.724**	**2.967**	0.805
	Slope Coefficients (Berkeley normalized to 1)			
UCLA	1.045	**1.422**	0.895	**1.398**
San Diego	**0.837**	1.054	**0.741**	0.999
Davis	**0.808**	0.998	0.933	1.286
Irvine	**0.817**	0.940	**0.757**	1.121
Santa Barbara	**0.756**	0.900	**0.760**	0.887
Santa Cruz	**0.520**	**0.714**	**0.535**	**0.771**
Riverside	**0.810**	**0.778**	**0.802**	0.867
	Nesting parameter			
ρ	**0.5355**		**0.4368**	

quartiles, with Riverside being a bit of an outlier in having very high science graduation rates.

Students in the bottom quartile who are interested in the sciences have much higher probabilities of graduating in the non-sciences at top schools than at the bottom schools. Hence, the overall graduation probability is fairly flat across schools for students whose initial major is science. To sum up, for those interested in the sciences, the school attended has small effects on graduation probabilities but larger effects on what major the student will graduate with.

For non-science majors, overall graduation rates are higher, particularly for those in the bottom quartile. Initial non-science majors in the bottom quartile have graduation probabilities that are seven percentage points higher than their science counterparts with little variation across college selectivity. The similar gap for the top quartile is around four percentage points.

As with the descriptive statistics, results are starker for four year graduation rates which are displayed in Table **??**. Bottom quartile students interested in the sciences would only have a 2.1% chance of graduating in four years at Berkeley, with the corresponding number at Riverside at 13.3%. The non-science four year graduation rates for those who begin in the sciences are fairly stable across institutions. This is in contrast to five year graduation rates where the top schools were particularly good at graduating initial science students in non-science fields. The overall impact on graduation rates results in much higher four year graduation rates at lower tier schools for those who begin in the sciences. Four year graduation rates are also lower at the top schools in the non-sciences as well, though the results are not as strong as for sciences.

The message of the two tables is then that the school attended affects one's probability of finishing in the sciences as well as finishing in four years, particularly for those with lower SAT scores. Weighed against this are benefits not measured in this paper, such as that a degree from a top school may be more valuable than a degree from a school lower down.

5 Counterfactuals

We now turn to analyzing the role affirmative action plays in affecting major choice.

Table **??** shows how graduation probabilities changed for minorities using pre-Proposition 209 data as a base. In particular, we consider three cases:

1. Reassigning the pre-Proposition 209 sample according to the post-Proposition 209 rules.

Table 6: Predicted Minority 5 Year Graduation Rates by School, SAT Quartile, and Initial Major

		Berkeley	UCLA	San Diego	Davis	Irvine	UCSB	Santa Cruz	Riverside
		Probability of Graduation in Science							
Science	Q1	11.1%	14.7%	17.7%	15.4%	15.6%	21.1%	20.9%	22.2%
	Q2	22.9%	26.9%	29.0%	28.4%	27.4%	34.9%	31.3%	37.4%
	Q3	32.8%	36.3%	37.1%	38.2%	36.3%	44.1%	38.4%	47.2%
	Q4	43.7%	46.1%	45.5%	48.4%	45.5%	53.4%	45.6%	56.9%
Non-Science	Q1	1.7%	2.1%	3.3%	3.5%	3.1%	1.5%	3.8%	5.2%
	Q2	3.7%	4.1%	5.8%	7.1%	5.7%	2.9%	5.7%	10.7%
	Q3	6.1%	6.1%	8.1%	10.9%	8.3%	4.5%	7.4%	16.8%
	Q4	9.3%	8.7%	10.9%	15.6%	11.4%	6.5%	9.2%	23.6%
		Probability of Graduation in Non-Science							
Science	Q1	41.8%	35.9%	34.3%	32.5%	39.3%	30.0%	34.2%	31.6%
	Q2	38.7%	33.1%	30.3%	28.6%	35.5%	24.2%	31.1%	23.7%
	Q3	34.1%	29.3%	26.7%	24.3%	31.3%	19.9%	28.3%	18.4%
	Q4	28.6%	25.2%	22.9%	19.9%	26.9%	15.6%	25.5%	13.4%
Non-Science	Q1	58.3%	55.4%	55.9%	50.5%	58.5%	59.1%	58.3%	55.4%
	Q2	64.1%	61.9%	59.7%	55.0%	62.9%	63.8%	62.7%	55.3%
	Q3	66.8%	65.5%	61.6%	56.7%	64.9%	66.4%	65.2%	53.1%
	Q4	66.8%	66.3%	61.5%	55.5%	64.5%	66.9%	65.9%	48.9%
		Probability of Graduation Total							
Science	Q1	53.0%	50.7%	52.0%	47.9%	54.9%	51.1%	55.1%	53.8%
	Q2	61.6%	60.0%	59.3%	56.9%	62.8%	59.1%	62.4%	61.1%
	Q3	66.9%	65.6%	63.8%	62.5%	67.6%	64.0%	66.7%	65.6%
	Q4	72.3%	71.3%	68.4%	68.3%	72.4%	69.0%	71.1%	70.3%
Non-Science	Q1	60.0%	57.5%	59.2%	53.9%	61.6%	60.6%	62.1%	60.6%
	Q2	67.8%	66.0%	65.5%	62.1%	68.5%	66.7%	68.4%	66.1%
	Q3	72.9%	71.6%	69.7%	67.6%	73.1%	70.9%	72.6%	69.9%
	Q4	76.1%	75.0%	72.4%	71.1%	75.9%	73.5%	75.2%	72.5%

Table 7: Predicted Minority 4 Year Graduation Rates by School, SAT Quartile, and Initial Major

		Berkeley	UCLA	San Diego	Davis	Irvine	UCSB	Santa Cruz	Riverside
		Probability of Graduation in Science							
Science	Q1	2.1%	3.0%	6.2%	4.0%	4.8%	8.0%	11.9%	13.3%
	Q2	7.4%	8.1%	13.9%	11.0%	11.0%	17.4%	20.2%	27.8%
	Q3	14.7%	14.2%	21.6%	19.0%	17.6%	26.2%	26.9%	39.6%
	Q4	25.0%	22.2%	30.6%	29.1%	25.5%	36.1%	34.2%	51.6%
Non-Science	Q1	0.2%	0.3%	0.8%	0.6%	0.5%	0.5%	1.8%	3.3%
	Q2	1.0%	1.0%	2.3%	2.1%	1.3%	1.7%	3.7%	9.7%
	Q3	2.7%	2.0%	4.3%	4.6%	2.3%	3.3%	5.6%	17.8%
	Q4	6.1%	3.7%	7.3%	8.7%	3.9%	6.0%	8.0%	28.1%
		Probability of Graduation in Non-Science							
Science	Q1	13.4%	9.5%	14.1%	9.1%	12.5%	10.2%	15.8%	14.1%
	Q2	15.0%	11.9%	14.9%	10.3%	14.3%	9.5%	15.9%	11.6%
	Q3	14.1%	12.4%	14.1%	9.8%	14.3%	8.2%	15.0%	9.0%
	Q4	11.9%	12.2%	12.6%	8.5%	13.5%	6.5%	13.6%	6.3%
Non-Science	Q1	27.4%	22.0%	31.9%	20.9%	29.9%	32.2%	39.5%	33.7%
	Q2	34.8%	31.4%	39.4%	28.7%	38.7%	39.1%	45.2%	36.6%
	Q3	39.3%	38.1%	43.8%	33.7%	44.4%	43.1%	48.4%	35.7%
	Q4	40.7%	42.1%	45.5%	35.3%	47.7%	44.6%	49.5%	31.4%
		Probability of Graduation Total							
Science	Q1	15.5%	12.5%	20.3%	13.1%	17.4%	18.2%	27.7%	27.4%
	Q2	22.4%	20.0%	28.9%	21.3%	25.4%	27.0%	36.0%	39.4%
	Q3	28.8%	26.6%	35.7%	28.7%	31.9%	34.4%	41.9%	48.7%
	Q4	36.8%	34.4%	43.2%	37.6%	39.0%	42.6%	47.8%	58.0%
Non-Science	Q1	27.6%	22.3%	32.7%	21.4%	30.4%	32.7%	41.3%	37.0%
	Q2	35.9%	32.4%	41.7%	30.8%	39.9%	40.7%	48.9%	46.4%
	Q3	42.0%	40.2%	48.1%	38.2%	46.7%	46.4%	54.0%	53.5%
	Q4	46.7%	45.9%	52.7%	44.1%	51.6%	50.6%	57.6%	59.4%

2. Reassigning the pre-Proposition 209 sample according to the post-Proposition 209 rules and additionally using the post-Proposition 209 production function to determine graduation probabilities.

3. Using the post-Proposition 209 sample and production function.

To get the post-Proposition 209 assignment rules, we estimate multinomial logits on the probability of minority students attending each of the schools in the data.

In particular, we assume that the payoff for attending school k

$$\begin{aligned} V_{ijk} &= v_{ijk} + \eta_{ijk} \\ &= AI_{is}\phi_{jks} + AI_{ih}\phi_{jkh} + \eta_{ijk} \end{aligned} \tag{6}$$

The probability of being assigned to each of the schools is then:

$$q_{ijk} = \frac{\exp(v_{ijk})}{\sum_{k'} \exp(v_{ijk'})} \tag{7}$$

We then estimate the parameters of (**??**) using data on enrollees in the three year period after Proposition 209 took effect, 1998-2000.

To obtain post-Prop 209 assignment for pre-Prop 209 students, we need a mapping between the academic indexes in the two periods. The clear issue is that the distribution of enrollees may be stronger in the post-Prop 209 period as some students may not be admitted to any UC school. Previous work by Card and Krueger (2005) and Antonovics and Backes (2012), however, argue that, in the period immediately following Prop 209, the minority application pool did not substantially change.

Under the assumption the application pool has not changed, we can calculate the minority academic indexes for both the science and the non-sciences in both the pre and post period. We then match academic indexes across periods by assuming that the Xth percentile student in the pre-period science index would be at the Xth percentile of the science index in the post period. We then are able to calculate the probabilities each pre-Prop 209 student would be 'assigned' to a particular school in the post period. Note that this exercise reshuffles the pre-Prop 209 sample among the various schools. It does not perform the counterfactual exercise of whether these students would have attended at all.[7]

[7]This approach would be valid for comparing post-Prop 209 effects if those students would have enrolled in schools of similar quality either in the CSU system, a public school outside of California, or in a private institution. There is some reason to believe, for example, that the effects on enrollment for affirmative action bans are small given that affirmative action is only in place at the top third of institutions. See Bowen and Bok (1998).

Reassigning minorities using the post-Proposition 209 assignment rules results in overall five year graduation rate increases of 0.5 and 0.2 percentage points (see Table 8) for initial science and non-science majors respectively. Graduation gains are highest–over two percentage points– for those at the bottom of the distribution whose initial major is in the sciences, while minorities at the top of the distribution see small decreases in their graduation probabilities, particularly if their initial major was not in the sciences. Five year persistence rates in the sciences are higher at 0.8 percentage points, implying drops in the share of individuals graduating in the non-sciences. Larger total effects can be found (1.4 and 1.7 percentage points) when considering 4 year total graduation rates (see Table 9), being these gains mainly driven by the students in the lowest four deciles of the index academic distribution.

Results in tables 8 and 9 not only suggest that Proposition 209 contributed to a better campus-student match in terms of, for example, graduation in the sciences, but also led to a response from the different UC schools by changing their production functions so that those students with weaker credentials were more likely to graduate. For instance, the third panel of each table show that total graduation rates in 4 and 5 years in the sciences would have increased (for the pre-sample) between 1.7 and 1.8 percentage points, if post assignment rules and post production functions were in effect, where around half of these improvements could be explained by changes in the production functions.

Finally, the last panels of tables 8 and 9 show the gains in 4 and 5 year graduation rates for different fields when considering the post sample, post assignment rules, and post production functions. Results show a 2.9 and 2.2 percent increase in science persistence and substantial gains (between 5 to 10 percent) in graduation rates for those students in the lowest deciles of the index distribution.

To sum up, the results suggest two main findings. First, no university has an absolute advantage in terms of graduating students in the sciences and, in particular, most selective schools do not do better with students that show weaker academic preparation. This suggests that Proposition 209 contributed to a better allocation of students across UC schools when considering graduates in science majors. Second, schools responded to the elimination of Proposition 209 by adjusting their production functions in order to improve the performance of minority students.

6 Conclusion

Table 8: Minority 5 Year Graduation Probabilities by Index Decile, and Initial Major with Different Production Functions and Assignment Rules

Grad. Cat.	Initial Major	1	2	3	4	5	6	7	8	9	10	Overall
		Grad. Probabilities for Pre Assignment Rules, Pre Production Function, Pre Sample										
Science	Science	8.0%	11.4%	14.0%	17.1%	19.5%	23.1%	27.3%	31.7%	37.6%	47.3%	26.5%
	Non-Science	1.6%	2.2%	2.7%	3.1%	3.5%	4.4%	5.0%	6.0%	7.2%	9.2%	4.3%
Non-Science	Science	27.6%	28.7%	30.1%	31.9%	33.8%	34.0%	33.7%	33.8%	32.9%	30.5%	32.0%
	Non-Science	45.9%	50.3%	53.4%	57.0%	60.4%	62.3%	64.9%	67.4%	69.9%	73.2%	59.7%
Total	Science	35.5%	40.1%	44.1%	48.9%	53.4%	57.0%	61.0%	65.5%	70.5%	77.8%	58.5%
	Non-Science	47.5%	52.5%	56.1%	60.1%	64.0%	66.7%	69.9%	73.4%	77.1%	82.4%	63.9%
		Gain from Using Post Assignment Rules										
Science	Science	0.5%	0.6%	0.7%	0.9%	0.9%	0.9%	0.9%	1.0%	0.8%	0.4%	0.8%
	Non-Science	0.3%	0.3%	0.4%	0.4%	0.5%	0.5%	0.5%	0.5%	0.5%	0.3%	0.4%
Non-Science	Science	1.6%	1.0%	0.6%	0.1%	-0.3%	-0.6%	-0.8%	-1.0%	-1.0%	-0.6%	-0.3%
	Non-Science	1.3%	0.6%	0.3%	-0.2%	-0.5%	-0.7%	-0.9%	-1.0%	-1.0%	-0.7%	-0.2%
Total	Science	2.1%	1.6%	1.4%	1.0%	0.6%	0.3%	0.1%	0.0%	-0.2%	-0.2%	0.5%
	Non-Science	1.5%	0.9%	0.6%	0.2%	-0.1%	-0.2%	-0.4%	-0.5%	-0.5%	-0.4%	0.2%
		Gain from Using Post Assignment Rules and Post Production Function										
Science	Science	1.4%	3.8%	4.3%	3.9%	3.6%	4.4%	2.6%	0.2%	-0.3%	-1.6%	1.8%
	Non-Science	-0.2%	0.2%	0.1%	0.0%	0.6%	1.1%	0.8%	0.3%	0.5%	0.3%	0.4%
Non-Science	Science	8.9%	6.1%	4.5%	3.0%	1.6%	-0.4%	0.0%	0.8%	0.1%	0.4%	1.9%
	Non-Science	7.2%	6.4%	6.0%	4.9%	3.1%	2.1%	1.8%	1.7%	1.0%	1.1%	3.7%
Total	Science	10.2%	9.9%	8.7%	6.9%	5.2%	3.9%	2.6%	1.0%	-0.3%	-1.2%	3.7%
	Non-Science	7.0%	6.6%	6.0%	4.9%	3.7%	3.2%	2.6%	1.9%	1.5%	1.4%	4.1%
		Gain from Using Post Assignment Rules, Post Production Function, and Post Sample										
Science	Science	5.3%	6.6%	6.6%	5.4%	5.1%	4.4%	3.1%	1.9%	-0.4%	-2.5%	2.9%
	Non-Science	0.2%	0.1%	0.3%	0.5%	0.7%	0.8%	0.8%	0.4%	0.2%	0.3%	0.6%
Non-Science	Science	4.2%	3.2%	2.1%	1.4%	0.0%	-0.5%	-0.5%	-0.9%	0.1%	1.5%	0.7%
	Non-Science	5.4%	6.0%	5.5%	4.2%	2.8%	2.4%	1.7%	1.5%	1.3%	1.2%	3.7%
Total	Science	9.5%	9.7%	8.6%	6.8%	5.0%	3.8%	2.5%	0.9%	-0.4%	-1.0%	3.6%
	Non-Science	5.6%	6.2%	5.8%	4.7%	3.5%	3.2%	2.6%	1.9%	1.5%	1.5%	4.3%

Table 9: Minority 4 Year Graduation Probabilities by Index Decile, and Initial Major with Different Production Functions and Assignment Rules

Grad. Cat.	Initial Major	1	2	3	4	5	6	7	8	9	10	Overall
		Grad. Probabilities for Pre-Assignment rules, pre production function, pre sample										
Science	Science	2.0%	3.3%	4.3%	5.5%	6.8%	8.2%	10.2%	13.3%	17.8%	28.4%	11.6%
	Non-Science	0.3%	0.6%	0.8%	1.0%	1.2%	1.5%	1.9%	2.4%	3.3%	5.8%	1.7%
Non-Science	Science	7.8%	9.0%	9.9%	10.6%	11.6%	12.4%	13.2%	13.9%	14.9%	15.6%	12.5%
	Non-Science	19.9%	23.8%	26.9%	29.5%	32.1%	34.4%	37.1%	40.6%	45.0%	51.0%	33.1%
Total	Science	9.8%	12.3%	14.2%	16.0%	18.3%	20.6%	23.4%	27.2%	32.7%	44.0%	24.1%
	Non-Science	20.2%	24.4%	27.6%	30.4%	33.3%	35.9%	39.0%	43.0%	48.3%	56.7%	34.9%
		Gain from Using Post Assignment Rules										
Science	Science	0.6%	1.0%	1.2%	1.3%	1.4%	1.3%	1.3%	1.3%	1.1%	0.3%	1.1%
	Non-Science	0.2%	0.3%	0.4%	0.5%	0.6%	0.6%	0.7%	0.7%	0.7%	0.5%	0.5%
Non-Science	Science	1.5%	1.3%	1.1%	0.8%	0.5%	0.3%	0.0%	-0.2%	-0.3%	-0.2%	0.3%
	Non-Science	2.3%	2.1%	1.9%	1.6%	1.3%	1.0%	0.7%	0.4%	0.1%	-0.2%	1.2%
Total	Science	2.1%	2.3%	2.2%	2.1%	1.9%	1.6%	1.3%	1.1%	0.7%	0.2%	1.4%
	Non-Science	2.5%	2.4%	2.2%	2.1%	1.9%	1.6%	1.4%	1.1%	0.8%	0.3%	1.7%
		Gain from Using Post Assignment Rules and Post Production Function										
Science	Science	1.1%	2.2%	2.3%	2.8%	3.3%	3.4%	3.0%	2.4%	1.2%	-2.4%	1.7%
	Non-Science	0.0%	0.1%	0.2%	0.2%	0.5%	0.5%	0.7%	0.8%	0.6%	0.5%	0.4%
Non-Science	Science	9.8%	7.3%	7.1%	5.8%	4.5%	3.7%	3.3%	2.4%	1.4%	0.8%	4.0%
	Non-Science	6.9%	6.6%	6.1%	6.0%	5.3%	5.7%	5.6%	5.3%	5.2%	4.6%	5.8%
Total	Science	11.0%	9.5%	9.4%	8.6%	7.7%	7.1%	6.3%	4.9%	2.7%	-1.6%	5.7%
	Non-Science	6.9%	6.7%	6.3%	6.2%	5.8%	6.2%	6.2%	6.0%	5.8%	5.1%	6.2%
		Gain from Using Post Assignment Rules, Post Production Function, and Post Sample										
Science	Science	1.9%	2.8%	2.9%	3.5%	3.8%	3.9%	3.5%	2.6%	1.4%	-2.0%	2.2%
	Non-Science	0.1%	0.1%	0.2%	0.3%	0.5%	0.7%	0.8%	0.9%	0.8%	1.0%	0.5%
Non-Science	Science	8.2%	6.1%	5.7%	4.7%	3.6%	3.0%	2.5%	2.1%	1.2%	0.7%	3.3%
	Non-Science	4.9%	5.7%	5.3%	5.2%	5.0%	4.9%	5.1%	4.7%	4.4%	4.0%	4.7%
Total	Science	10.1%	9.0%	8.7%	8.2%	7.4%	6.8%	6.1%	4.7%	2.6%	-1.4%	5.4%
	Non-Science	5.0%	5.9%	5.5%	5.5%	5.5%	5.6%	5.9%	5.6%	5.3%	5.0%	5.2%

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8 Appendix

Table 10: Majority 5 Year Graduation Rates by School, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
		Probability of Graduation in Science								
Science	Q1	29.7%	26.4%	33.3%	35.5%	26.8%	24.4%	22.1%	25.1%	27.5%
	Q2	52.4%	48.1%	46.4%	44.3%	36.6%	33.3%	29.3%	34.4%	40.5%
	Q3	57.5%	53.1%	51.3%	48.1%	41.5%	41.0%	31.6%	40.6%	48.9%
	Q4	63.0%	54.3%	58.5%	54.4%	43.8%	44.2%	37.3%	44.6%	56.7%
Non-Science	Q1	5.8%	6.8%	14.8%	12.6%	5.9%	3.5%	5.1%	8.1%	7.2%
	Q2	7.3%	8.4%	13.2%	12.6%	8.2%	3.8%	6.3%	16.5%	8.9%
	Q3	15.4%	11.8%	16.3%	15.1%	6.9%	4.9%	5.8%	26.3%	12.0%
	Q4	15.9%	12.9%	19.3%	17.7%	10.1%	5.7%	8.8%	29.5%	14.9%
		Probability of Graduation in Non-Science								
Science	Q1	35.1%	34.1%	29.8%	30.7%	32.3%	34.5%	35.1%	27.8%	32.0%
	Q2	31.8%	29.3%	28.1%	29.4%	30.3%	33.9%	31.3%	23.6%	30.0%
	Q3	29.8%	28.4%	25.7%	29.0%	25.6%	27.9%	35.5%	19.8%	27.8%
	Q4	23.1%	27.6%	23.5%	18.9%	28.5%	21.4%	33.6%	8.9%	24.0%
Non-Science	Q1	60.7%	62.4%	61.3%	56.2%	60.3%	66.0%	57.2%	51.2%	59.2%
	Q2	76.0%	72.9%	68.7%	66.2%	62.0%	68.7%	62.5%	46.2%	65.6%
	Q3	71.2%	75.2%	65.8%	62.2%	60.5%	68.4%	60.3%	39.3%	66.4%
	Q4	71.0%	72.8%	60.2%	58.3%	65.2%	68.3%	56.0%	44.0%	66.9%
		Probability of Graduation Total								
Science	Q1	64.9%	60.4%	63.1%	66.2%	59.1%	58.9%	57.1%	52.9%	59.5%
	Q2	84.3%	77.4%	74.5%	73.7%	66.9%	67.2%	60.6%	58.0%	70.5%
	Q3	87.2%	81.5%	77.0%	77.1%	67.1%	68.9%	67.1%	60.4%	76.7%
	Q4	86.0%	81.9%	82.0%	73.3%	72.3%	65.6%	70.9%	53.6%	80.8%
Non-Science	Q1	66.5%	69.3%	76.1%	68.8%	66.2%	69.5%	62.3%	59.2%	66.4%
	Q2	83.3%	81.3%	81.9%	78.7%	70.2%	72.5%	68.8%	62.7%	74.5%
	Q3	86.6%	87.0%	82.1%	77.3%	67.4%	73.2%	66.1%	65.6%	78.4%
	Q4	86.9%	85.7%	79.5%	76.0%	75.3%	74.0%	64.8%	73.5%	81.8%

Table 11: Majority 4 Year Graduation Rates by School, SAT Quartile, and Initial Major

Initial Major	SAT Quartile	Berkeley	UCLA	San Diego	Davis	Irvine	Santa Barbara	Santa Cruz	Riverside	Overall
		Probability of Graduation in Science								
Science	Q1	10.8%	14.3%	18.4%	10.7%	12.2%	12.5%	10.3%	13.5%	12.7%
	Q2	33.3%	20.8%	30.3%	18.9%	19.3%	18.4%	15.9%	22.8%	21.7%
	Q3	38.2%	29.0%	34.0%	23.4%	23.9%	26.6%	18.4%	21.8%	28.9%
	Q4	43.9%	32.0%	42.2%	28.9%	31.3%	26.5%	21.6%	32.1%	37.4%
Non-Science	Q1	1.6%	1.6%	5.3%	4.3%	2.4%	1.2%	3.2%	3.7%	2.8%
	Q2	4.6%	4.5%	7.9%	5.2%	3.0%	1.8%	3.4%	11.6%	4.5%
	Q3	9.6%	6.3%	10.0%	6.9%	3.0%	2.3%	3.2%	19.5%	6.7%
	Q4	10.2%	7.6%	12.1%	8.5%	6.0%	3.1%	5.2%	25.5%	9.3%
		Probability of Graduation in Non-Science								
Science	Q1	17.1%	13.1%	16.4%	13.7%	15.1%	15.2%	18.4%	17.1%	15.8%
	Q2	16.9%	14.5%	15.8%	13.8%	14.7%	14.3%	18.3%	14.8%	15.7%
	Q3	16.2%	15.4%	15.2%	13.9%	14.4%	13.6%	18.6%	12.9%	15.2%
	Q4	14.5%	15.4%	13.9%	13.5%	13.5%	12.5%	18.6%	10.7%	13.8%
Non-Science	Q1	38.5%	31.4%	38.6%	30.2%	37.4%	43.8%	39.2%	37.0%	36.4%
	Q2	43.5%	38.2%	43.0%	34.3%	41.9%	48.2%	42.5%	38.4%	43.6%
	Q3	47.2%	44.0%	45.9%	37.4%	45.4%	51.7%	45.0%	38.0%	45.9%
	Q4	49.8%	49.3%	47.2%	39.5%	48.1%	54.3%	47.1%	35.1%	47.1%
		Probability of Graduation Total								
Science	Q1	27.9%	27.4%	34.8%	24.4%	27.3%	27.7%	28.6%	30.6%	28.5%
	Q2	50.2%	35.2%	46.1%	32.7%	34.1%	32.8%	34.2%	37.6%	37.3%
	Q3	54.4%	44.4%	49.2%	37.3%	38.2%	40.2%	37.0%	34.7%	44.1%
	Q4	58.5%	47.4%	56.1%	42.4%	44.7%	38.9%	40.2%	42.8%	51.3%
Non-Science	Q1	40.1%	33.0%	43.9%	34.5%	39.8%	45.0%	42.4%	40.7%	39.2%
	Q2	48.1%	42.7%	51.0%	39.5%	44.9%	50.0%	45.9%	50.0%	48.1%
	Q3	56.8%	50.3%	55.9%	44.3%	48.4%	54.0%	48.2%	57.5%	52.6%
	Q4	60.0%	56.9%	59.4%	48.0%	54.1%	57.5%	52.3%	60.6%	56.4%

Table 12: Predicted Majority 5 Year Graduation Rates by School, SAT Quartile, and Initial Major

		Berkeley	UCLA	San Diego	Davis	Irvine	UCSB	Santa Cruz	Riverside
		Probability of Graduation in Science							
Science	Q1	21.8%	22.1%	29.5%	29.4%	25.4%	30.7%	27.7%	32.5%
	Q2	35.5%	35.1%	42.2%	41.6%	36.1%	42.1%	34.5%	44.2%
	Q3	46.2%	45.0%	51.4%	50.5%	43.9%	50.3%	38.9%	52.9%
	Q4	55.5%	53.6%	59.1%	57.9%	50.6%	57.0%	42.6%	60.0%
Non-Science	Q1	2.9%	3.4%	7.1%	7.8%	5.0%	4.0%	7.1%	12.0%
	Q2	5.0%	5.5%	10.7%	11.6%	7.2%	5.9%	8.6%	17.6%
	Q3	8.2%	8.4%	15.5%	16.5%	10.2%	8.5%	10.6%	24.9%
	Q4	12.7%	12.4%	21.9%	23.1%	14.1%	11.9%	12.9%	33.9%
		Probability of Graduation in Non-Science							
Science	Q1	42.9%	35.6%	32.8%	34.4%	35.6%	31.4%	32.2%	26.6%
	Q2	37.0%	32.3%	27.9%	29.3%	31.8%	26.6%	30.5%	21.1%
	Q3	32.3%	29.8%	24.7%	26.0%	29.5%	23.7%	30.2%	17.5%
	Q4	27.7%	27.0%	21.8%	22.9%	27.3%	21.1%	29.9%	14.6%
Non-Science	Q1	69.2%	61.4%	60.1%	60.6%	62.3%	65.4%	58.5%	50.7%
	Q2	72.4%	66.3%	62.2%	62.1%	65.2%	68.0%	61.0%	49.6%
	Q3	73.7%	69.3%	62.3%	61.7%	66.7%	69.3%	62.7%	46.6%
	Q4	73.1%	70.6%	60.5%	59.3%	66.9%	69.5%	63.8%	41.7%
		Probability of Graduation Total							
Science	Q1	64.7%	57.8%	62.3%	63.7%	61.0%	62.1%	59.9%	59.0%
	Q2	72.4%	67.3%	70.1%	70.9%	67.9%	68.7%	64.9%	65.3%
	Q3	78.6%	74.8%	76.1%	76.5%	73.5%	74.0%	69.1%	70.4%
	Q4	83.3%	80.6%	80.8%	80.8%	77.9%	78.2%	72.5%	74.6%
Non-Science	Q1	72.0%	64.7%	67.2%	68.4%	67.3%	69.4%	65.6%	62.7%
	Q2	77.4%	71.8%	72.9%	73.6%	72.4%	73.9%	69.6%	67.2%
	Q3	81.8%	77.7%	77.8%	78.2%	76.8%	77.8%	73.3%	71.4%
	Q4	85.8%	83.0%	82.3%	82.4%	81.0%	81.4%	76.8%	75.6%

Table 13: Predicted majority 4 year graduation rates by school, SAT quartile, and initial major

		Berkeley	UCLA	San Diego	Davis	Irvine	UCSB	Santa Cruz	Riverside
		Probability of Graduation in Science							
Science	Q1	8.5%	8.0%	16.1%	10.5%	11.5%	16.3%	14.3%	19.1%
	Q2	16.8%	15.6%	26.1%	17.8%	19.5%	25.5%	20.0%	30.4%
	Q3	25.7%	23.7%	35.0%	24.9%	27.2%	33.7%	24.8%	40.3%
	Q4	36.2%	33.3%	44.6%	33.0%	35.9%	42.4%	29.9%	50.5%
Non-Science	Q1	1.1%	1.2%	3.6%	2.7%	1.7%	1.9%	3.8%	6.3%
	Q2	2.3%	2.3%	6.0%	4.6%	3.1%	3.1%	5.1%	10.8%
	Q3	4.5%	4.1%	9.5%	7.4%	5.0%	4.9%	6.9%	17.0%
	Q4	8.4%	7.2%	15.0%	11.9%	8.4%	7.8%	9.4%	26.7%
		Probability of Graduation in Non-Science							
Science	Q1	17.1%	13.1%	16.4%	13.7%	15.1%	15.2%	18.4%	17.1%
	Q2	16.9%	14.5%	15.8%	13.8%	14.7%	14.3%	18.3%	14.8%
	Q3	16.2%	15.4%	15.2%	13.9%	14.4%	13.6%	18.6%	12.9%
	Q4	14.5%	15.4%	13.9%	13.5%	13.5%	12.5%	18.6%	10.7%
Non-Science	Q1	38.5%	31.4%	38.6%	30.2%	37.4%	43.8%	39.2%	37.0%
	Q2	43.5%	38.2%	43.0%	34.3%	41.9%	48.2%	42.5%	38.4%
	Q3	47.2%	44.0%	45.9%	37.4%	45.4%	51.7%	45.0%	38.0%
	Q4	49.8%	49.3%	47.2%	39.5%	48.1%	54.3%	47.1%	35.1%
		Probability of Graduation Total							
Science	Q1	25.6%	21.2%	32.5%	24.2%	26.5%	31.4%	32.7%	36.1%
	Q2	33.7%	30.1%	41.8%	31.6%	34.3%	39.8%	38.3%	45.2%
	Q3	41.9%	39.1%	50.2%	38.8%	41.6%	47.3%	43.4%	53.2%
	Q4	50.8%	48.7%	58.5%	46.4%	49.4%	54.9%	48.4%	61.2%
Non-Science	Q1	39.7%	32.6%	42.2%	32.9%	39.1%	45.7%	43.0%	43.3%
	Q2	45.8%	40.5%	49.0%	38.9%	45.0%	51.4%	47.6%	49.2%
	Q3	51.7%	48.1%	55.4%	44.8%	50.5%	56.6%	51.9%	55.0%
	Q4	58.1%	56.4%	62.2%	51.4%	56.5%	62.1%	56.5%	61.8%