

Predictors for CSUF Four-Year Graduation Rates of Transfer Students
Fall 1998 through Fall 2004 Cohorts

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Graduation rate is one measure of transfer student success. Four-year graduation rates for transfer students to CSUF were analyzed for cohorts starting from fall 1998 through fall 2004. Several variables are examined to identify the most predictive factors of graduation within a reasonable time period. A predictive statistical model reveals that full time (vs. part time) enrollment the first semester at CSUF, transfer GPA and the college of major were the most predictive variables. There were also rate differences by students' gender and ethnicity. These variables are first described individually to be more transparent than the statistical model. The slightly more technical results of the logistic regression model are then discussed. The non-graduate category is not necessarily an indicator of attrition, and those the students might graduate given a longer time frame.

Student characteristics of graduates vs. non-graduates

The data consist of all transfer students who entered CSUF from fall 1998 through fall 2004. Students entering CSUF in either fall or spring semesters were combined for this analysis, thus anyone graduating within eight consecutive semesters is considered a four-year graduate. Summer graduates are counted as part of the previous spring term.

The tables below show the counts and percentages of four-year graduates within the categories of each variable. A total of 33,839 transfer students entered during this period, and 21,778 (64%) graduated within four academic years.

Table 1 compares rates for students who enrolled full time (12 or more semester units) their first semester. Those beginning with full-time course loads had a four-year rate of over 20% higher than those beginning as part timers. Clearly those with the resources, time and commitment level required of full-time study at the beginning were much more likely to maintain the course levels required for graduation within a moderate amount of time.

Table 1: Graduation rates by first semester unit level.

Unit Level	Grads	Non-Grads	Total	Grad Rate
Full time	15,618	6,105	21,723	72%
Part time	6,160	5,956	12,116	51%
Total	21,778	12,061	33,839	64%

Table 2 shows the relationship of transfer grade point average on graduation rates. The data clearly show that past academic performance is related to the likelihood of graduation. Graduation rates rise steadily with increased transfer GPAs.

Table 2: Graduation rates by GPA category¹.

GPA Category	Grads	Non-Grads	Total	Grad Rate
2.00-2.19	810	906	1,716	47%
2.20-2.39	1,477	1,317	2,794	53%
2.40-2.59	2,275	1,752	4,027	56%
2.60-2.79	2,961	1,873	4,834	61%
2.80-2.99	3,340	1,703	5,043	66%
3.00-3.19	3,300	1,478	4,778	69%
3.20-3.39	2,611	988	3,599	73%
3.40-3.59	1,956	644	2,600	75%
3.60-3.79	1,245	385	1,630	76%
3.80-4.00	809	215	1,024	79%
Total	20,784	11,261	32,045	65%

The graduation rates for different colleges of major at entry varied substantially as shown in Tables 3a and 3b. The biggest differences are between majors in the colleges of Natural Science and Mathematics (NSM) and Engineering and Computer Science (ECS) on the low end, and majors in the three colleges of Communications, Humanities and Social Sciences (HSS) and Health and Human Development (HHD) on the high end. Majors in the Mihaylo College of Business and Economics (MCBE) and College of Arts were in the middle range at a rate four percent below the overall rate.

Table 3a: Graduations by college of major at entry.

College of Major	Grads	Non-Grads	Total	Grad Rate
Communications	2,770	947	3,717	75%
HHD	3,210	1,202	4,412	73%
HSS	6,939	3,114	10,053	69%
Arts	1,403	928	2,331	60%
MCBE	6,016	4,045	10,061	60%
NSM	625	658	1,283	49%
Other	214	258	472	45%
ECS	601	909	1,510	40%
Total	21,778	12,061	33,839	64%

¹ Students with missing GPAs are excluded, thus the totals are different than other tables.

However, the graduation rates across years of entry are fairly stable, as is shown in table 3b. Even within college of major, the rates don't vary that much from year to year.

Table 3b: Graduation rates by college of major at entry by year of entry.

College of Major	1998	1999	2000	2001	2002	2003	2004	Total
Communications	72%	75%	74%	74%	74%	77%	74%	75%
HHD	76%	73%	74%	74%	70%	73%	71%	73%
HSS	69%	67%	68%	70%	71%	69%	69%	69%
Arts	65%	57%	61%	56%	62%	61%	62%	60%
MCBE	59%	58%	61%	59%	60%	60%	60%	60%
NSM	46%	48%	49%	43%	51%	49%	56%	49%
Other	38%	41%	49%	41%	52%	55%	50%	45%
ECS	40%	39%	45%	42%	33%	41%	38%	40%
Total	64%	63%	65%	64%	65%	65%	65%	64%

Table 4 shows that women transfers graduate at a higher rate than their male counterparts. The women's total is more than 10% higher than the men's.

Table 4: Graduations by gender.

Gender	Grads	Non-Grads	Total	Grad Rate
Women	13,907	6,393	20,300	69%
Men	7,871	5,668	13,539	58%
Total	21,778	12,061	33,839	64%

Table 5 shows the rates by ethnic category. The larger ethnic groups have graduation rates that range from 61% to 69%. Most notably the non-residents (i.e., international non-citizens) and Whites are at the upper end, while Hispanics and Asians are a few percentage points lower. Despite being a traditionally underrepresented group, the Hispanic rate is almost identical to the overall rate. The lowest overall rates are for American Indians and Blacks in the mid to upper 50 percent range. However, these two groups also make up a substantially lower proportion of the overall total, and as such their percentages are subject to larger variances due to modest fluctuations in their totals.

Table 5: Graduations by ethnic category.

Ethnic Category	Grads	Non-Grads	Total	Grad Rate
Non-resident	1,328	609	1,937	69%
White	8,366	4,048	12,414	67%
Unknown	2,434	1,398	3,832	64%
Hispanic	4,759	2,779	7,538	63%
Asian	4,296	2,753	7,049	61%
American Indian	137	100	237	58%
Black	458	374	832	55%
Total	21,778	12,061	33,839	64%

College Migration

Students typically graduated in the same academic area as their original major chosen during the application process. Overall, nearly 90% of four-year transfer graduates remained in their college of entry. However, when transfer students change majors, they sometimes change to a completely different college. Table 6 shows the migration breakdown between colleges.

By far the largest migration rate was for those admitted to majors in ECS and NSM. Approximately 27% of four-year graduates, who began with majors in either of those colleges, obtained their degrees in majors from other colleges. Nearly half of those ECS students switched to majors in MCBE, while the NSM changers tended toward majors in HSS and HHD. A small percentage of ECS majors switched to NSM, but the reverse was almost non-existent. The largest percentage increase was in HHD, with a net increase of 2% (17% vs. 15%) of the four-year graduates since enrollment.

Table 6: College of Entry by College of Degree.

College of Entry	% of Apps.	College of Degree						
		Comm	HHD	HSS	Arts	MCBE	NSM	ECS
Communications	13%	92%	2%	5%	0%	1%	0%	0%
HHD	15%	1%	94%	5%	0%	0%	0%	0%
HSS	32%	2%	7%	90%	0%	1%	0%	0%
Arts	6%	4%	1%	5%	89%	1%	0%	0%
MCBE	28%	2%	1%	3%	0%	94%	0%	0%
NSM	3%	2%	7%	12%	0%	5%	73%	0%
Other	1%	14%	21%	32%	13%	15%	3%	1%
ECS	3%	2%	2%	5%	1%	13%	4%	72%
Total	100%	14%	17%	32%	6%	27%	2%	2%

Statistical prediction

A statistical model was fit to the data to identify the most important predictors, and quantify the change in probability (on average) that someone would graduate within four years. Logistic regression is an appropriate model for predicting two-category outcomes while providing information to interpret the influence of each variable. Other models may not be appropriate for binary data (e.g., ordinary least squares regression), be as commonly available and tested (e.g., probit or complementary log-log), or not as interpretable (e.g., neural networks). Given that we are mainly interested in prediction and the sample size is very large compared to the number of variables, statistical significance is not of much importance here. Virtually any variable added would have a low enough p-value to be considered “significant” by traditional measures. Rather, the variables in the model presented below were chosen because of their predictive qualities and general importance in institutional reporting.

The analytical results of the model are shown in Table 7. The variables and their specific categories (if applicable) are shown in the left two columns. Transfer GPA is a quantitative variable that was rescaled by a factor of 10 to be more interpretable. The last categories within each variable shown in bold are used as reference categories. The parameter estimates are mainly useful for statistical purposes, and here only their sign is interpretable.

Table 7: Estimates from the logistic regression analysis.

Variable	Comparison	Param. Est.	Odds Ratio	% Chg. of Odds	Avg. Prob.
Intercept		-1.91			
Unit level	Full time	.93	2.53	153%	0.212
	Part time	0			
College of Major	Arts	-.54	0.58	-42%	-0.123
	MCBE	-.41	0.67	-33%	-0.093
	Communications	.27	1.31	31%	0.061
	ECS	-1.14	0.32	-68%	-0.260
	HHD	.24	1.27	27%	0.055
	NSM	-.89	0.41	-59%	-0.204
	OTHER	-.99	0.37	-63%	-0.225
	H&SS	0			
Transfer GPA X 10		.08	1.08	8%	0.018
Gender	Men	-.21	0.81	-19%	-0.047
	Women	0			
Ethnic Category	American Indian	-.33	0.72	-28%	-0.076
	Asian	-.05	0.95	-5%	-0.011
	Black	-.32	0.72	-28%	-0.074
	Latino	-.09	0.92	-8%	-0.020
	Non-res.	.37	1.45	45%	0.085
	Unknown	-.10	0.91	-9%	-0.022
	White	0			

Odds ratios are presented because logistic regression operates on a log-odds scale, and can be calculated from the parameter estimates. If two groups are equally likely to graduate, their odds ratio will be one (i.e., the odds of graduating are the same for each group). An odds ratio greater than one indicates that group is more likely to graduate than the reference group, while a fraction between zero and one indicates the opposite is true. The change in percentage of odds column converts the odds ratio to the relative increase in odds between the two groups.

Although odds and odds ratios are most natural mathematically, probabilities are easier to interpret. The final column presents the average change in probabilities. For example, for each tenth of an increase in Transfer GPA, the probability of graduating increases an average of .018. We use the “average” change because they are not constant over the range of all possible values, but these values are a decent approximation. For categorical data, the probabilities are in comparison to the reference category, which essentially acts as the zero point in the model. For example, the College of Humanities and Social Sciences (HSS) is the reference category for the College of Major variable. Transfer students with a major in the College of Engineering and Computer Science (ECS) have an estimated average probability of graduating that is 26% less than those in HSS, while those in the College of Communications have an average estimated probability that is 6% higher than HSS.

The model estimates that those who enrolled full time in their first semester have an average of 21.2% greater probability of a four-year graduation than those starting part time. The Transfer GPA variable was re-scaled for the logistic regression so that the estimates are in tenths of grade points. For each tenth of a point in Transfer GPA, the model estimates that the probability of graduation will increase by approximately 1.8%. Similarly, men are estimated to graduate almost 5% less than women, and ethnic groups other than non-residents are less likely to graduate than whites, according to the model.

The probability comparisons between non-reference-category groups can be calculated by simple subtraction. We essentially create a new reference category by subtracting its value from the comparison group. Thus those in the College of Communications are estimated to have a 32.1% greater likelihood of graduating than those in ECS ($.061 - -.260 = .321$), and Hispanics have a 5.4% greater predicted likelihood than Blacks ($-.020 - -.074 = .054$).

The individual estimates from the model deviate from the true proportions in the data for several reasons. The most important is that the model is optimized to fit all of the data taken over several predictors simultaneously. Second, the predictors themselves are correlated, thus they may show differences from the data. For example, the women’s graduation rate is about 10% higher than the men’s rate, but the model only predicts about a 4.7% difference. This is partly because women tend to have higher Transfer GPAs, while making up a higher percentage in Communications but lower percentages in ECS, amongst other things. Thus, large differences in individual variables do not necessarily indicate they will have the same importance in the model.

Additional findings and conclusions

If we examine two academically related variables in more detail, we can see some important differences. Table 8a shows the count distributions of four-year transfer enrollees by Transfer GPA Category and College of Major at entry, while Table 8b shows the data as percentages of graduates.

Table 8a: Transfer enrollees by Transfer GPA Category and College of Major.

Transfer GPA Category	College of Major								Total
	Comm	HHD	HSS	Arts	MCBE	NSM	Other	ECS	
2.00-2.19	194	208	552	59	485	70	44	104	1,716
2.20-2.39	349	359	887	100	815	105	43	136	2,794
2.40-2.59	470	551	1,192	205	1,213	169	59	168	4,027
2.60-2.79	534	683	1,439	274	1,435	187	49	233	4,834
2.80-2.99	568	782	1,420	337	1,504	159	70	203	5,043
3.00-3.19	492	615	1,410	390	1,417	184	59	211	4,778
3.20-3.39	365	445	1,097	343	1,037	114	43	155	3,599
3.40-3.59	261	312	761	237	796	109	28	96	2,600
3.60-3.79	167	179	456	181	494	68	12	73	1,630
3.80-4.00	96	100	291	101	337	47	14	38	1,024
Total	3,496	4,234	9,505	2,227	9,533	1,212	421	1,417	32,045

Table 8b: Four-year graduation rates by Transfer GPA Category and College of Major.

Transfer GPA Category	College of Major								Total
	Comm	HHD	HSS	Arts	MCBE	NSM	Other	ECS	
2.00-2.19	63%	61%	55%	32%	35%	26%	43%	29%	47%
2.20-2.39	68%	68%	59%	36%	43%	38%	35%	23%	53%
2.40-2.59	67%	68%	64%	48%	49%	41%	37%	23%	56%
2.60-2.79	72%	72%	66%	58%	54%	46%	51%	38%	61%
2.80-2.99	79%	72%	71%	60%	61%	45%	50%	45%	66%
3.00-3.19	77%	75%	73%	63%	68%	51%	53%	45%	69%
3.20-3.39	77%	78%	76%	73%	71%	59%	51%	52%	73%
3.40-3.59	85%	77%	77%	68%	76%	61%	54%	59%	75%
3.60-3.79	82%	83%	80%	69%	76%	68%	50%	55%	76%
3.80-4.00	92%	84%	80%	66%	80%	74%	50%	66%	79%
Total	75%	73%	69%	61%	60%	49%	47%	41%	65%

Tables 8a and 8b show the combined effects of Transfer GPA and College of Major. In general, there is a consistent upward trend as GPA increases, but between-college differences are similar within GPA

categories. This is an empirical illustration that the two variables contribute to the statistical model with their main effects, and why adding an interaction term for the two variables would not provide much predictive power beyond the main effects. However, some regions of the table are interesting to note. Although rates in ECS are generally the lowest, those with Transfer GPAs below 2.60 are especially unlikely to have graduated in four years. The trend in NSM is similar but less extreme. Both of those colleges don't see a 50% grad rate unless the Transfer GPAs are above 3.0, where the rates improve noticeably. In contrast, the colleges of Arts and MCBE have low rates in the bottom GPA categories, but the rates increase steadily over higher categories. The pattern of steady increase also occurs in colleges with higher overall rates. To borrow a term from psychometrics, the Transfer GPA variable provides a bit more *discrimination* in the colleges of ECS and NSM (especially at the lower end) than it does in the other colleges.

Overall the likelihood of graduation for transfer students was strong at a rate of almost two-thirds within four years for the fall 1998 through fall 2004 cohorts. Indicators of academic commitment, past performance and college of major were strong predictors of four-year graduation. Gender and ethnicity were also predictors, but their predictive effects were somewhat attenuated by the academic factors with which they are correlated.