Comprehensive Study of Undergraduate Student Success at a Land Grant University College of Agricultural Sciences, 1990-2014.

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Abstract

The United States Department of Agriculture and others have identified the need for educated agriculturalists. Given the financial constraints of most institutions, it is important that decision makers are strategic in our programming. This study offers a rigorous and systematic approach to assess programmatic needs in three segments. Using Colorado State University (CSU) as a case study for this systematic assessment, CSU was found to not represent the state it serves, Colorado. Further, statistically significant opportunity gaps were found for gender, Pell eligibility, first generation status, residency and minority students. Finally, the first year retention, four-year graduation rate and six-year graduation rate predictive models provided evidence for program investment to support first generation, minority and resident students. Of note, non-minority students were found to be 1.78 times more likely to graduate in four years than were minority students. Minority students were 53% less likely to graduate than majority students in six years. First generation students were less likely than non-first generation students to graduate in six years and residents were more likely to graduate than non-residents of the state within the six-year time frame.

Introduction

In recent years, there has been a noted shift in the demographics of students who study agricultural sciences, in particular, animal sciences (Buchanan, 2008; Burk et al., 2013). This documented shift toward more women, more ethnically diverse students and students from non-rural communities is likely to increase. According to the United States (US) Census Bureau, the US is projected to become more ethnically and racially diverse (US Census Bureau, 2015). The Hispanic (Latino) population alone is projected to grow from 17.4% in 2014 to 28.6% in 2060 while it is projected that 64.4% of people under 18 will identify as Hispanic in 2060 versus 48% in 2014.

These statistics confirm what those in higher education have been predicting. In March of 2013 readers of The Chronicle of Higher Education were alerted that *"sharply increasing diversity will soon hit many states and institutions with freight-train force"* (Hoover, 2013). Further, Hoover stated that *"as these changes take hold, meeting the needs of minority students, especially those from underrepresented groups, will play a greater role in defining institutional success."* If institutions of higher education are to be prepared for this "freight-train", it is important to assess both historical and current educational trends for our students, including our minority students, to objectively guide educational efforts.

Meanwhile, the United States Department of Agriculture and others have identified the need for educated agriculturalists ("Education," n.d.; "How to Feed the World in 2050", n.d.). Universities, particularly Land Grant institutions need to identify how to both recruit and successfully graduate people prepared to lead as professional agriculturalists (Fogel, 2012; Association of Public Land-Grant Universities, [APLU], 2009). There are not enough people graduating with degrees in agricultural fields (APLU, 2009; Jones and Larke, 2001). It is a foundational assumption of this research that those who have been a part of agricultural labor are a critical answer to the societal need for educated agriculturalists; there is space for all, including Hispanics and other ethnic groups, in agricultural education and not just in the labor pool.

Given the financial constraints of most institutions, it is important that we are strategic in our programming to support undergraduate students. Most institutions do not have the luxury of such abundant resources that they can address all possible opportunity gaps. Instead, we need to prioritize our programming. Perhaps the most prevailing inequalities in agricultural higher education are associated with ethnicity, gender, socio-economic status, residency and first generation status. Perhaps

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these opportunity gaps have remained consistent over the past twenty years. The problem is that we do not yet have a standardized and systematic approach to assessing whether or which opportunity gaps exist in our Colleges of Agricultural Sciences (CAS) as Land Grant institutions. The purpose of this study is to thoroughly examine agricultural higher education demographics at one Land Grant institution from 1990-2014 to guide future program investment. In so doing, this approach may also be employed by other Land Grant institutions wherein we could benchmark and set growth goals for both recruitment and retention.

Methods

A descriptive, non-experimental and comparative quantitative research approach is employed (Morgan et al., 2009; Morgan et al., 2011). This study uses anonymized secondary data provided to the researchers from the university's institutional research office and received approval via the Internal Review Board to conduct the analysis. The analysis includes three distinct segments. First, this study compared quantitatively the demographics of those studying agriculture at a Land Grant university, CSU as the case study, over a 24-year period and assess whether these demographics are reflective of the overall population of the state of the institution, Colorado. Second, this study employed statistical tests of difference to assess opportunity gaps for retention to second year, first year grade point average (GPA), final or current GPA, four-year graduation rate and six-year graduation rate for gender, Pell eligibility (data available for years 1992–2014), first generation status, residency status and ethnicity as defined by majority (White) and minority (non-White). The third segment focused on recent trends and utilized logistic regression analysis of the data for students who began in the fall semesters of 2003 through 2008.

In the first segment, demographics of the undergraduate populations within CSU's CAS were investigated to determine the gender and ethnic representation between 1990 and 2014. Second, the demographics of the CAS were compared numerically and visually with those of the Colorado. Theoretically, the most valid method for this comparison is using a visual aid such as a pie chart to depict the demographic differences because the data sets used for this investigation are separate from and unrelated to the state's census data set (Huck, 2008; Thompson, 2008). To honor this theoretical construct, pie charts were developed to show the ethnic percentages for Colorado in 1990, 2000 and 2010, compared to the ethnic percentages for the University's CAS undergraduate students in similar years. Of note, in 2010 Colorado census participants could select more than one ethnicity. Further, a statistical test was desired to quantify any observed differences. To explore differences statistically, expected frequencies were calculated for the CAS 1990, 2000 and 2010 data sets to match the demographics of the state. A Chi Square Goodness of Fit test was then employed to compare the ethnic percentages observed in the comparison years for the CSU CAS undergraduate students to what is expected if the CAS is representative of Colorado's ethnic demographics. (Morgan et al., 2011; Morgan et al., 2009). Finally, to test whether the calculated ratio of Colorado population percentage as compared to the CSU CAS population percentage representation for the largest minority population in the state, Hispanics/Latinos, has changed over time, such ratios were calculated for 1990, 2000 and 2010.

In the second segment, independent samples t tests were run to investigate first year GPA and final or current GPA opportunity gaps (difference) for the CAS undergraduate population between 1990 and 2014. Pearson Chi Square tests were run to investigate retention to second year, four-year graduation and six-year graduation opportunity gaps for the CAS undergraduate population between 1990 and 2014. The level of significance was set to 99% to insure the investigation against Type 1 error (Morgan et al., 2011; Morgan et al., 2009). The first round of t tests asked if there was a difference in first year GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. The second round of t tests asked if there was a difference in final/current GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. The first round of Chi-Square tests asked if there was a difference in retention to the second year for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. In the Chi-Square statistics for retention to the second-year study abroad students were counted as retained and the one deceased student was counted as not retained. The second round of chi square tests asked if there was a difference in four-year graduation rates for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students. Finally, the third round of t-tests asked if there was a difference in six-year graduation rates for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents/non-residents and majority/minority students.

The third segment focuses on recent trends for the undergraduate students. The analysis used data from the cohorts entering in the fall semesters of 2003 through 2008 in three separate step wise logistic regression models to assess whether the predictor variables of gender, ethnicity (minority/majority), residency status, Pell eligibility and first generation status are significant predictors for retention to second year, four-year graduation, or six-year graduation.

Table 1. Ethnicity percentages						
Source	European American/White	Hispanic/ Latino	Asian/Pacific Islander	African American	Native American	Other
Colorado in 1990	80.7%	12.9%	1.8%	4.0%	0.8%	5.1%
1990 CAS undergraduate students	90.1%	2.2%	2.6%	0.7%	0.7%	5.3%
Colorado in 2000	74.5%	17.1%	2.3%	3.8%	1.0%	7.2%
2000 CAS undergraduate students	87.6%	3.2%	2.5%	0.7%	1.9%	4.2%
Colorado in 2010	81.3%	20.7%	2.9%	4.0%	1.1%	7.2%
2010 CAS undergraduate students	85.3%	4.7%	0.9%	0.2%	0.6%	6.0%

Results

Segment 1: Statistical Differences for Ethnicity Representation within the CSU CAS as compared to the demographics of Colorado

Table 1 shows the ethnicity percentages for Colorado based on the 1990, 2000 and 2010 census. For comparative purposes, Table 1 also shows the ethnicity percentages for the 1990, 2000 and 2010 CAS undergraduate students. It is visually obvious that CAS demographics are not similar in ethnic composition of Colorado in 1990, 2000 and 2010. A statistical test is not necessary to observe, for example, that in 1990 2.2% of the CSU CAS undergraduate population was Hispanic/Latino while the Hispanic/Latino population for the state was 12.9%. One can also distinguish a difference in 2000 between the Hispanic/Latino for Colorado, 17.1% and the Hispanic/Latino representation in the College, 3.2%. Again, in 2010, the difference between the 20.7% Hispanic/Latino population for the state of Colorado and the 4.7% Hispanic/Latino representation for the 2010 undergraduate students is readily observable.

To further illustrate whether CAS demographics were similar in ethnic composition of Colorado, the results from Chi Square Goodness of Fit tests are shown in Table 2. For 1990, 2000 and 2010 the CAS Hispanic/Latino and African American undergraduate representation is significantly lower than expected. For Asians/Pacific Islanders (combined) the Chi Square results were significant in 2010. In 2010, Asian student representation within CAS was less than expected and Pacific Islander representation was more than expected. In 2000, the Native American population was significantly lower than expected.

Finally, to test whether the calculated ratio of Colorado population percentage as compared to the CSU CAS population percentage representation for the largest minority population in the state, Hispanics/Latinos, has changed over time, such ratios were calculated for 1990, 2000 and 2010. In 1990 the ratio is 5.9, in 2000 the ratio is 5.3 and in 2010 the ratio is 4.4. The relative representation of the CSU CAS is decreasing, that is, CSU's CAS was more representative of the state of Colorado in 1990 than it was in 2010.

Segment 2: Opportunity Gaps for CAS Undergraduate Students 1990-2014

Table 3 presents the results of the first round of t-tests which queried if there was a difference in first year GPA for females/males, Pell eligible/non-eligi-

ble, first generation students/non-first generation students, residents/non-residents and majority/minority students; d is also shown as an interpretation of the strength of the relationship or effect size (Morgan et al., 2011; Morgan et al., 2009; Cohen, 1988). At the $p<0.01$ level, males had a significantly lower first year GPA than female, students not eligible for Pell grants had a significantly higher first year GPA than students eligible for Pell grants, non-first generation students had a significantly higher first year GPA than first generation students, residents had a significantly lower first year GPA than non-residents and majority students had a significantly higher first year GPA than minority undergraduates. For all the first-year GPA t-test results the effect size was small or smaller than typical. Table 4 presents the results of the second round of t tests which asked if there was a difference in final/current GPA for females/males, Pell eligible/non-eligible, first generation students/non-first generation students, residents of Colorado/non-residents and majority/minority students. At the $p<0.01$ level, males had a significantly lower final/current GPA than females, students not eligible for Pell grants had a significantly higher final/current GPA than students eligible for Pell grants, non-first generation students had a significantly higher final/current GPA than

Table 2. Chi Square Goodness of Fit analysis comparing observed demographics within the CAS undergraduate population with the demographics of State			
Ethnic Population	1990 CAS Undergraduates	2000 CAS Undergraduate	2010 CAS Undergraduates
Hispanic/Latino	$\chi^2=67.0$	$\chi^2=158.8$	$\chi^2=156.5$
Asian/Pacific Islander	$\chi^2=2.4$	$\chi^2=0.2$*	Asian: $\chi^2=16.7$ Pacific Islander: $\chi^2=5.6$*
African American	$\chi^2=21.2$	$\chi^2=35.3$	$\chi^2=42.2$
Native American	$\chi^2=0.2$	$\chi^2=10.0$	$\chi^2=2.5$
*CAS representation greater than expected as compared to Colorado's population			

Table 3. Independent t test analysis for differences in first year grade point average for CAS undergraduate students for multiple demographics				
Tested demographic	Mean GPA	t	99% Confidence Interval	d
Male/female	2.8/3.0	-6.8*	-0.24 - -0.11	0.03
Pell eligible/not eligible	2.9/3.0	2.9*	0.01 – 0.19	0.15
First generation/not first generation	2.9/3.0	3.1*	0.01 – 0.14	0.12
Residents/non-residents	2.9/3.0	-2.7*	-0.12 - -0.003	0.09
Majority/minority	3.0/2.8	4.2*	0.06 – 0.26	0.23
*Significant at P<0.01				

Table 4. Independent t-test analysis for differences in final or current grade point average for CAS undergraduate students for multiple demographics				
Tested demographic	Mean GPA	t	99% Confidence Interval	d
Male/female	2.7/2.9	-5.0*	-0.22 - -0.07	0.18
Pell eligible/not eligible	2.7/2.9	3.7*	0.04 – 0.25	0.18
First generation/not first generation	2.7/2.9	4.9*	0.07 – 0.21	0.17
Residents/non-residents	2.9/2.9	-1.7	-0.11 – 0.02	0.05
Majority/minority	2.9/2.7	4.6*	0.08 – 0.29	0.22
*Significant at P<0.01				

first generation students, majority students had a significantly higher final/current GPA than minority undergraduates. No significant difference in final/current GPA was found for residents/non-residents. For all final/current GPA t-test results the effect size was small or smaller than typical.

To investigate whether females and males differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 5 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=0.03, df=1, n=4135, p=0.9). Females are not more likely than expected under the null hypothesis to have low or high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.003. The retention to second year rate for females was 85.6% and the retention to second year rate for males was 85.8%.

To investigate whether Pell eligible and non-eligible students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 6 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=6.34, df=1, n=4135, p=0.01). Pell eligible are more likely than expected under the null hypothesis to have low rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.003, which is a small or smaller than typical effect size. The retention to second year rate for Pell eligible students was 82.1% and the retention to second year rate for non-Pell eligible students was 86.2%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 7 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=22.84, df=1, n=4135, p=0.001). First generation students are more likely than expected under the null hypothesis to have low rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.074, which is a small or smaller than typical effect size. The retention to second year rate for first generation students was 81.6% and the retention to second year rate for non-first generation students was 87.4%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 8 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=6.27, df=1, n=4135, p=0.01). Residents are more likely than expected under the null hypothesis to have high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.039, which is a small or smaller than typical effect size. The retention to second year rate for residents was

Table 5. Pearson Chi Square analysis of prevalence in retention to second year for CAS undergraduate students among females and males

Variable	n	Males	Females	χ^2	p
			Gender		
Retention to 2nd year				0.03	0.9
Yes	3544	1008	2536		
No	591	166	425		
Totals	4135	1174	2961		

Table 6. Pearson Chi Square analysis of prevalence in retention to second year for Pell eligible and non-Pell eligible CAS undergraduate students

Variable	n	Non-eligible	Eligible	χ^2	p
			Pell		
Retention to 2nd year				6.34	0.01
Yes	3544	3123	421		
No	591	499	92		
Totals	4135	3622	513		

Table 7. Pearson Chi Square analysis of prevalence in retention to second year for first generation and non-first generation CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		First Generation			
Retention to 2nd year				22.84	0.001
Yes	3544	2577	967		
No	591	373	218		
Totals	4135	2950	1185		

Table 8. Pearson Chi Square analysis of prevalence in retention to second year for residents of Colorado and non-residents of the CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		Residency of Colorado			
Retention to 2nd year				6.27	0.01
Yes	3544	1674	1870		
No	591	312	279		
Totals	4135	1986	2149		

Table 9. Pearson Chi Square analysis of prevalence in retention to second year for majority and minority CAS undergraduate students

Variable	n	Majority	Minority	χ^2	p
		Race			
Retention to 2nd year				2.30	0.130
Yes	3544	3152	392		
No	591	513	78		
Totals	4135	3665	470		

87.0% and the retention to second year rate for non-residents was 84.3%.

To investigate whether majority and minority students differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 9 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=2.30, df=1, n=4135, p=0.130). Majority students are not more likely than expected under the null hypothesis to have low or high rates of retention to the second year. Phi, which indicates the strength of the association between the two variables, is 0.024. The retention to second year rate for majority students was 86.0% and the retention to second year rate for minority students was 83.4%.

To investigate whether females and males differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 10 shows the

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Pearson Chi-Square results and indicates that there is a significant association (χ^2=11.962, df=1, n=4135, p=0.001). Females are significantly more likely than expected under the null hypothesis to have high four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.054, which is a small or smaller than typical effect size. The four-year graduation rate for females was 36.6% and the four-year graduation rate for males was 30.9%.

To investigate whether Pell eligible and non-Pell eligible students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 11 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=19.389, df=1, n=4135, p=0.001). Pell eligible undergraduate students are more likely than expected under the null hypothesis to have low rates four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.068, which is a small or smaller than typical effect size. The four-year graduation rate for Pell eligible students was 26.3% and the four-year graduation rate for non-Pell eligible students was 36.2%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 12 shows the Pearson Chi-Square results and indicates that there is not a significant association at the 99% confidence level (χ^2=4.580, df=1, n=4135, p=0.032). Phi, which indicates the strength of the association between the two variables, is 0.033. The four-year graduation rate for first generation students was 32.5% and the four-year graduation rate for non-first generation students was 36.0%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 13 shows the Pearson Chi-Square results and indicates that there is not a significant association at the 99% confidence level (χ^2=5.514, df=1, n=4135, p=0.019). Phi, which indicates the strength of the association between the two variables, is 0.037. The four-year graduation rate for residents was 36.7% and the four-year graduation rate for non-residents was 33.2%.

To investigate whether majority and minority students differ on whether they have high or low four-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 14 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=36.078, df=1, n=4135, p=0.001). Majority students are significantly more likely than expected under the null hypothesis to have high four-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.093, which is a small or smaller than typical effect size. The four-year graduation

rate for majority students was 36.6% and the four-year graduation rate for minority students was 22.6%.

To investigate whether females and males differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 15 shows the Pearson Chi-Square results and indicates that there is not a significant association (χ^2=2.313, df=1, n=4135, p=0.128). Females are not more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.024. The six-year graduation rate for females was 54.2% and the six-year graduation rate for males was 56.8%.

To investigate whether Pell eligible and non-Pell eligible students differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 16 shows the Pearson Chi-Square results and indicates

Table 10. Pearson Chi-Square analysis of prevalence in four-year graduation rates for CAS undergraduate students among females and males

Variable	n	Males	Females	χ^2	p
			Gender		
Four-year graduation				0.03	0.9
Yes	1447	363	1084		
No	2688	811	1877		
Totals	4135	1174	2961		

Table 11. Pearson Chi-Square analysis of prevalence in four-year graduation rates for Pell eligible and non-Pell eligible CAS undergraduate students

Variable	n	Non-eligible	Eligible	χ^2	p
			Pell		
Four-year graduation				19.389	0.001
Yes	1447	1312	135		
No	2688	2310	378		
Totals	4135	3622	513		

Table 12. Pearson Chi-Square analysis of prevalence in four-year graduation rates for first generation and non-first generation CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		First Generation			
Four-year graduation				4.580	0.032
Yes	3544	2577	967		
No	591	373	218		
Totals	4135	2950	1185		

Table 13. Pearson Chi-Square analysis of prevalence in four-year graduation rates for residents and non-residents of the CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		Residency of Colorado			
Four-year graduation				5.514	0.019
Yes	1447	659	788		
No	2688	1327	1361		
Totals	4135	1986	2149		

Table 14. Pearson Chi-Square analysis of prevalence in four-year graduation rates for majority and minority CAS undergraduate students

Variable	n	Majority	Minority	χ^2	p
			Race		
Four-year graduation				36.078	0.001
Yes	1447	1341	106		
No	2688	2324	364		
Totals	4135	3665	470		

Table 15. Pearson Chi-Square analysis of prevalence in six-year graduation rates for CAS undergraduate students among females and males

Variable	n	Males	Females	χ^2	p
			Gender		
Six-year graduation				2.313	0.128
Yes	2272	667	1605		
No	1863	507	1356		
Totals	4135	1174	2961		

Table 16. Pearson Chi-Square analysis of prevalence in six-year graduation rates for Pell eligible and non-Pell eligible CAS undergraduate students

Variable	n	Non-eligible	Eligible	χ^2	p
			Pell		
Six-year graduation				55.921	0.001
Yes	2272	2069	203		
No	1863	1553	310		
Totals	4135	3622	513		

Table 17. Pearson Chi-Square analysis of prevalence in six-year graduation rates for first generation and non-first generation CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		First Generation			
Six-year graduation				21.517	0.001
Yes	2272	1688	584		
No	1863	1262	601		
Totals	4135	2950	1185		

Table 18. Pearson Chi-Square analysis of prevalence in six-year graduation rates for residents of Colorado and non-residents of the CAS undergraduate students

Variable	n	No	Yes	χ^2	p
		Residency of Colorado			
Six-year graduation				16.141	0.001
Yes	2272	1027	1245		
No	1863	959	904		
Totals	4135	1986	2149		

Table 19. Pearson Chi-Square analysis of prevalence in six-year graduation rates for majority and minority CAS undergraduate students

Variable	n	Majority	Minority	χ^2	p
		Race			
Six-year graduation				40.022	0.001
Yes	2272	2078	194		
No	1863	1587	276		
Totals	4135	3665	470		

that there is a significant association (χ^2=55.921, df=1, n=4135, p=0.001). Pell eligible undergraduate students are more likely than expected under the null hypothesis to have low six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.116, which is a small or smaller than typical effect size. The six-year graduation rate for Pell eligible students was 39.6% and the six-year graduation rate for non-Pell eligible students was 57.1%.

To investigate whether first generation students and non-first generation students differ on whether they have high or low six-year graduation rates a chi-square statistic was conducted. Assumptions were checked and were met. Table 17 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=21.517, df=1, n=4135, p=0.001). First generation undergraduate students are more likely than expected under the null hypothesis to have low six-year

graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.072, which is a small or smaller than typical effect size. The six-year graduation rate for first generation students was 49.3% and the six-year graduation rate for non-first generation students was 57.2%.

To investigate whether residents and non-residents differ on whether they have high or low retention to the second year a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 18 shows the Pearson Chi-Square results and indicates that there is a significant association at the 99% confidence level (χ^2=16.141, df=1, n=4135, p=0.001). Residents are more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.062, which is a small or smaller than typical effect size. The six-year graduation rate for residents was 57.9% and the six-year graduation rate for non-residents was 51.7%.

To investigate whether majority and minority students differ on whether they have high or low six-year graduation rates a Chi-Square statistic was conducted. Assumptions were checked and were met. Table 19 shows the Pearson Chi-Square results and indicates that there is a significant association (χ^2=40.022, df=1, n=4135, p=0.001). Majority students are significantly more likely than expected under the null hypothesis to have high six-year graduation rates. Phi, which indicates the strength of the association between the two variables, is 0.098, which is a small or smaller than typical effect size. The six-year graduation rate for majority students was 56.7% and the six-year graduation rate for minority students was 41.3%.

Segment 3: Predictive models for CAS undergraduate student 2003-2008

Table 20 depicts the characteristic of the CAS undergraduate students in the cohorts entering in the fall semesters of 2003-2008. These variables (Minority, Gender, Resident, Pell Recipient, First Generation, Retained to Second Fall, Graduated in four years and Graduated in six years) were utilized to create predictive models through logistic regression analysis for retention to second fall, four-year graduation and six-year graduation.

Table 20. Characteristics of College of Agricultural Sciences undergraduate students, cohorts entering the university Fall 2003-2008. Variables listed were included in final models for prediction of retention to second fall, four-year graduation, and six-year graduation

Demographic Variable	Yes n (percentage)	No n (percentage)
Minority	120 (10.1%)	1066 (89.9%)
Female (Gender)	841 (71.0%)	344 (29.0%)
Resident	666 (56.2%)	519 (43.8%)
Pell Recipient	194 (16.4%)	991 (83.6%)
First Generation	368 (31.1%)	817 (68.9%)
Retained Second Fall	1019 (86.0%)	166 (14.0%)
Graduated in 4 years	501 (42.3%)	684 (57.5%)
Graduated in 6 years	799 (67.4%)	386 (32.6%)

Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict retention from first year to second year first semester defined as first-year retention rate. This model had little value since the zero-order model predicted 86% of the cases. In other words, most students went on to their second year so the variables added little to the by chance model. Nagelkerke squared was 0.04, so the model did improve by a few percentage points. (Chi-Square=27.07, p<0.001). Perhaps not surprisingly, non-first generation students were far more likely to be retained in the second year (Odds Ratio 1.65), than first generation students. Minority status was not a significant contributor to the model.

Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict four-year graduation rates. The assumptions of observations being independent and independent variables being linearly related to the log were checked and met. The model predicted 16% of the variance (Nagelkerke Squared=0.159). The Chi-Square=137.34 (2), p<0.001. This is like a R=0.4 or a medium to large effect size Cohen's (1988). In this model the primary contributor to the equation was minority status. Non-minority students were 1.78 (Odds ratio 1.784) times more likely to graduate in four years than were minority students.

The last Logistic regression was conducted to assess whether the predictor variables of gender, minority/majority, residency, Pell eligibility and first generation status were used in various combinations to predict six-year graduation rates. The assumptions of observations being independent and independent variables being linearly related to the log were checked and met. After multiple iterations of Logistic Regression, the best predictive model accounted for 12% of the variance or in other words, our ability to predict graduation rates was increased by 12% from the zero-order model (Nagelkerke R^2=0.12). This is equivalent to Cohen's r effect size of R=0.33 which is considered a typical or medium effect size (Morgan et al., 2013). The model that predicted the best included minority status, residency and first generation status. Although other predictors were significant alone, when all variables were placed into the model collinear effects of gender and Pell eligible fell out and minority status, residency and first generation status were the best predictors of six-year graduation rate.

Discussion

The purpose of this study was to thoroughly examine demographics at one land-grant institution from 1990-2014 to guide future program investment. This examination was conducted through three separate yet related segments. Whether through pie charts or Chi Square Goodness of Fit, the first segment of this analysis clearly demonstrates that this CAS is not currently representative of the ethnic demographics of the state it serves. In fact, it's representation of Hispanic/Latino students has decreased from 1990-2010. This begs the question of whether the CAS is meeting its land grant mission when it so clearly does not represent the state. Given the significance of the differences found in 1990, 2000 and 2010 for CAS Hispanic/Latino and African American undergraduate under-representation this is an area that has great recruitment potential. The recruitment model previously published in the NACTA Journal may serve as a model for recruitment efforts and future study (Talbert et al., 1997).

The second segment of this study shed light on many opportunity gaps for undergraduate students entering the university through 1990-2014. Male students had significantly lower first year GPAs and final/current GPAs and four-year graduation rates than female students. The practical significance of the GPA differences could be argued but it does indicate an area of investigation as to why male students have lower GPAs. Further investigation could also look at if there is a difference in first year salary or admission into graduate school for male students given their lower GPAs as there may be no practical implication to the lower GPAs. The difference in four-year graduate rates found here indicates that support for male students to graduate sooner is warranted. Pell eligible students had significantly lower first year GPAs and final/current GPAs than non-Pell eligible students; Pell eligible students also had significantly lower retention to second year rates, four-year graduation rates and six-year graduation rates than non-Pell eligible students. Once again, the practical significance of the lower GPA can be argued. However, the academic and financial effects of the differences in retention to the second year as well as four and six-year graduation rates for Pell eligible students clearly indicates that they need more support. The opportunity gap analysis also indicates that there is a significant need for more support and programming targeted at first generation students. First generation students had significantly lower first year and final/current GPAs. First generation students also were significantly less likely to be retained to the second year and they had significantly lower six-year graduation rates. Even the four-year graduation rate warrants scrutiny as the chi-square statistic is close to significant at p=0.032 indicating an opportunity gap in every area studied for first generation students. Resident students are being significantly outperformed by non–residents in terms of first year GPA. However, residents are significantly more likely to be retained to the second year and they have significantly higher six-year graduation rates. There are also a number of statistically significant opportunity gaps for minority students studying in the CAS. Minority students had significantly lower first year GPAs and final/current GPAs. Minority students also had a significantly lower four-year graduation rate and a lower six-year graduation rate than majority students.

These differences indicate that there is a need for more support and programming for minority students as well.

The third segment was targeted at current trends within the CAS. As such, this segment of the study was focused on the cohorts of undergraduate students entering in the fall semesters of 2003 through 2008 in three separate step wise logistic regression models to assess whether the predictor variables of gender, ethnicity (minority/majority), residency status, Pell eligibility and first generation status are significant predictors for retention to second year, four-year graduation and six-year graduation. The evidence found in the model for first-year retention gives a modest amount of support targeted at first generation students; this finding was further supported by the opportunity gap evidence found in segment two of the investigation. However, the logistic regression models did show predictive value for some of our variables for four and six-year graduation rates. Of note, non-minority students were found to be 1.78 times more likely to graduate in four years than were minority students with minority status being the primary contributor to the model. In the final investigated model, the strongest predictor of six-year graduation rate was minority/majority status. Minority students were 53% less likely to graduate then majority students in six years. First generation students were less likely than non-first generation students to graduate in six years and non-residents were more likely to graduate than residents of the state within the six-year time frame.

At least at this College of Agricultural Science, this rigorous analysis of undergraduate data does not support the notion that the College is achieving the land grant Mission. The CAS is not representative of the state population. Additionally, in the historical analysis, numerous differences were found in student success indicators such as retention to the second year, first year GPA, final/current GPA, four-year graduation rates and six-year graduation rates. Furthermore, in the analysis of current opportunity gaps, gender, Pell-eligibility, minority status, first generation status and residency all played a significant role in predicting some level of student success. These findings provide further evidence that this College of Agricultural Sciences is not successful in achieving its mission. Idealistic mission aside, this investigation is clear in its findings that with the changing demographics of the United States, it will be difficult to educate sufficient numbers of professional agriculturalists if the current student success gaps are not addressed. The purpose of this study was to thoroughly examine agricultural higher education demographics at one land-grant institution from 1990-2014 to guide future program investment. Future research can employ this approach at other land grant institutions. In so doing, agricultural educators could benchmark and set growth goals for both recruitment and retention.

Summary

In 2009, Slaughter told those reading the Chronicle of Higher Education that it was "time to get angry about underserved students" (Slaughter, 2009, p. A68). Slaughter argued that the lack of attention to underserved populations like Hispanics and African-Americans threatened United States preeminence in higher education. While the need for anger can be argued, based on the findings of this study, the need for more investment in programming for Pell-eligible, first generation and minority students is clear.

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