Observed and Predicted Retention by Department

Purpose

This report describes the difference between a department's retention rate (observed) and what rate might be expected based solely on the department's cohorts' student characteristics (predicted). Student characteristics vary considerably between departments; therefore, comparing the observed rates without considering the student attributes could be misrepresentative.

Data

The current report is based on data from the FA08-FA12 first-time, full-time (FTFT) freshman cohorts. Data from the five most recent cohorts is used to balance the competing demands of using the timeliest cohorts and having departments with enough students to warrant quantitative comparisons. First-year retention is defined as a student returning to CSU for their second-fall semester. Students' department is defined as their department of major at census of their first-fall semester.

Methodology

Logistic regression models are used to obtain the predicted probability that each student will be retained to their second-fall semester. Models are run by college grouping (the colleges of Liberal Arts and Health and Human Sciences are further broken down due to the heterogeneity of departments within these colleges) which allows the coefficients to vary by college while the predictor variables remain constant. These models mirror prior work by IR and control for student demographics (residency, gender, first generation status, Pell recipient status, minority status) and academic preparation (index). Results vary considerably by college and a discussion of these results is included as an addendum report.

Once the predicted retention rate for each student is obtained these rates are used to calculate an average predicted rate by department as well as a 95% confidence interval surrounding each department's average predicted rate. Departments with less than 25 students from the five cohorts included in this study are excluded. The percentage point (PP) difference between a department's observed and predicted retention rates is a measure of whether the department has a retention rate that is above or below what would be expected after controlling for the cohorts' characteristics. The confidence interval around the predicted rate provides a metric to determine if the PP difference is larger than what could be expected by chance.

Limitations

There are several limitations that need to be considered when interpreting the percentage point (PP) difference between observed and predicted retention rates for each department.

First, this analysis is descriptive in nature and cannot warrant causal interpretations. Interpretations can only state departments that have retention rates that are higher or lower than what would be expected based on the cohorts' characteristics and cannot be used to imply that departments cause the higher or lower rates.

Second, this analysis only includes student attributes in the prediction models; therefore, the academic rigor of departments is ignored. A department with high levels of, unmeasured, rigor might attract high achieving students who may also be retained at a lower level (due to the rigor), which would result in higher than reasonable predicted retention rates. The exclusion of academic rigor in the logistic regression models could be a significant source of bias in the predicted values.

Third, this analysis ignores the longitudinal nature of students' department of major. A student's departmental experience that has the largest impact on their first-year retention rate could occur in their second semester which may or may not be the same department as their cohort department.

Thus, the usefulness of this report is to highlight departments that should be further explored to identify any policies or departmental practices that could be associated with the higher/lower than expected retention rates.

Results

The table below displays the observed and predicted retention rates by departments (ordered alphabetically within college). Non-highlighted departments have observed retention rates that are statistically the same as the predicted rate; however, highlighted departments have an observed rate that is different than the predicted rate (red highlights lower than expected; green highlights better than expected).

Observed verse Predicted First Year Retention Rates by Department

College	Department[1]	Number of Students[2]	Observed Retention Rate[3]	Predicted Retention Rate[4]	PP Difference[5]	Lower Bound Predicted[6]	Upper Bound Predicted[7]
Agricultural Sciences	Agricultural & Resource Economics	122	84.6%	83.6%	0.90	82.4%	84.9%
	Animal Sciences	749	84.7%	85.3%	-0.62	84.8%	85.9%
	Horticulture & Landscape Archtctr	140	86.5%	84.8%	1.70	83.7%	86.0%
	Soil and Crop Sciences	38	86.8%	84.4%	2.44	81.7%	87.1%
Business	Business Intra-College	1618	87.9%	87.8%	0.09	87.6%	88.0%
Engineering	Chemical and Biological Engineering	246	88.9%	89.9%	-0.98	89.3%	90.4%
	Civil and Environmental Engineering	500	89.9%	88.2%	1.68	87.8%	88.6%
	Electrical and Computer Engineering	267	86.0%	89.1%	-3.05	88.5%	89.6%
	Engineering Intra-College	572	91.6%	89.0%	2.61	88.6%	89.3%
	Mechanical Engineering	714	87.5%	88.8%	-1.25	88.5%	89.1%
Health and Human Sciences	Construction Management	294	87.2%	87.1%	0.09	86.7%	87.5%
	Design and Merchandising	543	82.5%	82.3%	0.23	81.7%	82.9%
	Food Science & Human Nutrition	365	82.2%	82.6%	-0.47	81.9%	83.3%
	Health and Exercise Science	1041	83.0%	83.4%	-0.41	83.0%	83.9%
	Human Development & Family Studies	315	84.1%	82.7%	1.46	81.9%	83.4%
	School of Social Work	125	81.6%	82.0%	-0.40	80.8%	83.2%
Intra-University	Provost / Acad Vice President	6018	82.7%	82.7%	0.00	82.6%	82.9%
Liberal Arts	Anthropology	79	87.3%	85.2%	2.16	84.3%	86.0%
	Art	449	79.5%	81.5%	-1.98	80.8%	82.2%
	Communication Studies	190	83.8%	79.3%	4.43	78.3%	80.4%
	Economics	73	85.7%	83.7%	1.98	82.7%	84.8%
	English	362	79.9%	81.8%	-1.81	81.1%	82.4%
	Foreign Languages & Literatures	79	85.0%	81.5%	3.47	80.1%	82.9%
	History	206	83.8%	84.6%	-0.78	84.0%	85.2%
	Journalism & Technical Commnction	345	85.8%	86.8%	-0.98	86.5%	87.2%
	Liberal Arts Intra-College	267	80.7%	81.6%	-0.94	80.9%	82.4%
	Music, Theatre, & Dance	409	84.7%	82.4%	2.29	81.6%	83.2%
	Political Science	271	86.8%	84.7%	2.13	84.2%	85.2%
	Sociology	214	82.8%	84.3%	-1.46	83.7%	84.8%
Natural Sciences	Biochemistry & Molecular Bio	213	82.2%	86.3%	-4.13	85.6%	87.1%
	Biology	1717	85.4%	83.6%	1.78	83.3%	83.9%
	Chemistry	199	83.3%	85.6%	-2.31	84.7%	86.4%
	Computer Science	259	89.7%	87.4%	2.24	86.9%	87.9%
	Mathematics	146	85.8%	86.9%	-1.10	86.1%	87.7%
	Natural Sciences Intra-College	28	78.6%	85.2%	-6.61	83.0%	87.4%
	Physics	85	84.7%	85.8%	-1.09	84.3%	87.2%
	Psychology	906	81.1%	82.9%	-1.77	82.5%	83.3%
Veterinary Medicine & Biomedical Sci	Biomedical Sciences	439	92.7%	92.4%	0.34	92.0%	92.8%
	Environmntl & Radiolgicl Health Sci	55	82.1%	84.8%	-2.65	81.6%	88.0%
	Microbiolgy, Immunolgy and Patholgy	147	86.6%	86.3%	0.32	84.6%	87.9%
Warner College of Natural Resources	Fish/Wildlife/Conservation Biology	259	85.9%	86.1%	-0.20	85.4%	86.8%
	Forest & Rangeland Stewardship	242	86.8%	85.7%	1.13	84.9%	86.4%
	Geosciences	47	87.5%	86.1%	1.42	84.6%	87.5%
	Human Dimensions of Natural Res.	91	81.3%	84.9%	-3.58	83.9%	85.9%

[1] Only includes departments that have a cumulative cohort size (FA08-FA12) of more than 25 students

[2] Includes FTFT freshman from the FA08-FA12 cohorts

[3] The overall retention rate for FTFT freshman from the FA08-FA12 cohorts by department

[4] The department's average predicted probability obtained from the logistic regression models described in the Addendum

[5] The percentage point (PP) difference is equal to the observed retention rate minus the predicted retention rate.

[6, 7] The lower (upper) bound range of the 95% confidence interval around the average predicted probability by department

Summary of Results

- Among the 44 departments included in this analysis, 30 have an observed retention rate that is outside of the predicted retention rate's 95% confidence interval.
  - For instance, Anthropology has an observed retention rate of 87.3%, which is 2.16 PP's above the predicted retention rate of 85.2%. This is higher than expected since the upper bound rate of the predicted retention rate's confidence interval is 86%.
  - Human Dimensions of Natural Resources has an observed retention rate of 81.3% which is 3.58 PP lower than the predicted rate of 84.9%. This is lower than expected since the lower bound rate of the predicted retention rate's confidence interval is 83.9%.
- It is important to consider the number of students in each department when assessing which departments to further explore.
  - Utilizing departments as a strategy to improve the overall retention rate requires the intervention to occur in departments with large enough cohorts to impact the overall rate.
  - The ability to detect PP differences that are larger than could be expected by chance is highly sensitive to the number of students in each department. In other words, the smaller the number of students the larger the confidence interval and the bigger the PP difference needed to detect a rate that is higher or lower than expected.
- Among the 30 departments with an observed rate that is outside the predicted rate's confidence interval, 13 have retention rates that are higher than expected and 17 have retention rates that are lower than expected.
  - Departments with higher than expected retention rates (by at least 1 PP) and at least 200 students over the five cohorts are:
    - Forest & Rangeland Stewardship; Human Development & Family Studies; Civil and Environmental Engineering; Biology; Political Science; Computer Science; Music, Theatre, & Dance; Engineering Intra-College
  - Departments with lower than expected retention rates (by at least 1 PP) and at least 200 students over the five cohorts are:
    - Biochemistry & Molecular Biology; Electrical and Computer Engineering ; Art; English; Psychology; Sociology; Mechanical Engineering
  - Veterinary Medicine & Biomedical Sciences, Intra-University, and Business are the only colleges that are not represented in both the higher and lower than expected groups. All of the departments in these colleges have observed retention rates that are within the predicted retention rate's 95% confidence interval.
- The overall second fall retention rate for CSU (during this time period) is 84.6%.
  - There are 18 departments with observed retention rates lower than CSU's overall rate.
    - Among these 18 departments, 2 have higher than expected observed rates (Communication Studies and Human Development & Family Studies).
  - There are 25 departments with observed retention rates that are higher than the overall CSU rate.
    - Among these 25 departments, 6 have lower than expected observed rates. Mechanical Engineering and Animal Sciences are among these departments and have a very large number of students.
- Undeclared students (Intra-University) have a retention rate (82.7%) that is very similar to their predicted retention rate. Despite having a lower retention rate (compared to the CSU overall) undeclared students are retained at a rate expected given their demographics and academic preparation.

Addendum: Demographic Variation by College Grouping

In the main report, regression models are used to calculate the predicted probability of being retained. The purpose of this section is to review the variation in demographic/academic control variables by college grouping. The data used for this analysis includes the FA08-FA12 FTFT freshman cohorts including students who start in departments with less than 25 students, which are excluded from the department level analysis in the main report.

College Grouping

Running the logistic regression models by college grouping allows the regression coefficients to vary by college grouping while keeping the control variables constant. The departments in Liberal Arts and Health and Human Sciences are quite heterogeneous; therefore, these colleges warranted further breakdown. Liberal Arts is divided into three groups: arts (Art; Music, Theatre, and Dance), humanities (Communication Studies; English; Foreign Languages & Literatures; Liberal Arts Intra-college; Philosophy), and social sciences (Anthropology; Economics; Ethnic Studies; History; Journalism & Technical Communication; Political Science; Sociology). Health and Human Sciences is divided into two groups: Construction Management and all other departments.

Demographics by College Grouping

Table A1, below, displays the descriptive statistics for the demographic and academic control variables included in the regression models.

Table A1.

Descriptive Statistics of Demographic/Academic Control Variables by College Grouping

College Grouping (N)	Minority	Female	Resident	Pell	First Generation	Index (average)
Agricultural Sciences (1061)	13.7%	75.7%	54.6%	21.2%	30.1%	114.6
Business (1656)	12.5%	46.6%	82.2%	16.1%	19.7%	119.1
Engineering (2340)	12.4%	22.9%	75.5%	14.4%	17.4%	123.1
Health and Human Sciences- Excluding CM (2417)	16.6%	80.1%	81.6%	20.6%	24.9%	111.7
Health and Human Sciences- CM only (296)	12.2%	6.8%	81.8%	15.5%	27.0%	107.5
Intra-University (6104)	18.3%	49.7%	82.9%	21.7%	27.2%	108.6
Liberal Arts- Arts (861)	14.9%	69.8%	84.6%	23.7%	23.3%	115.6
Liberal Arts- Humanities (919)	15.7%	73.3%	79.9%	21.9%	22.5%	114.1
Liberal Arts- Social Sciences (1206)	21.0%	55.5%	81.4%	23.0%	27.7%	113.6
Natural Sciences (3591)	21.2%	64.8%	74.3%	23.4%	27.7%	116.9
Veterinary Medicine & Biomedical Sci (645)	16.3%	73.5%	70.9%	16.0%	19.4%	125.4
Warner College of Natural Resources (652)	10.9%	39.9%	58.1%	15.6%	20.2%	114.7

N includes all FTFT freshman from the FA08-FA12 cohorts

Regression Results by College Grouping

Table A2 displays the logistic regression results for first-year retention by college grouping.

Table A2.

Logistic Regression Results for Demographic/Academic Control Variables by College Grouping

	AS	BU	EG	HHS- no CM	HHS- CM only	IU	LA- Arts	LA- Humanities	LA- Social Sciences	NS	CVMBS	WCNR
Odds Ratios[1] Associated with Demographic/Academic Control Variables												
Minority (Non-Minority)	NS	0.69	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Female (Male)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Resident (Non-Resident)	1.55	1.68	1.85	1.81	NS	1.56	1.73	1.57	1.59	1.76	2.27	1.51
Pell (Non-Pell)	0.61	NS	0.63	NS	NS	0.84	0.56	NS	NS	0.82	NS	NS
First Generation (Non-First Generation)	0.67	0.53	NS	0.50	NS	0.76	NS	0.47	NS	0.70	NS	NS
Index	1.04	NS	1.04	1.03	NS	1.03	1.04	1.01	1.02	1.03	1.07	1.03
Model Fit												
N[2]	1056	1652	2299	2410	294	6018	858	913	1194	3553	641	647
Cases Correctly Predicted by Model (%)	85.1	87.8	88.9	82.9	87.1	82.7	81.9	81.2	85.2	84.2	90.5	85.8

[1]Odds ratios are only displayed when their significance level is less than .1, "NS" indicates the control variable is not significant in the model

[2]The number of students included in the regression models is reduced from the overall cohort size due to some students missing an index score

Interpretations of Results by College Grouping

This section discusses the results from tables A1 and A2 by college grouping.

Agricultural Sciences (AS)

Agricultural Sciences (AS) is the college with the highest percentage of first generation students and the lowest percentage of resident students. AS also has relatively low representation of minority students and relatively high proportions of females.

In terms of the multivariate associations obtained from the logistic regression, first-year retention among the AS cohorts (after controlling for the other variables in the model) is negatively associated with first generation (compared to non-first generation) and Pell recipients (compared to non-Pell) and positively associated with index and residency (compared to non-resident).

The negative association between first generation status and first-year retention is noteworthy because AS serves the largest proportion of first generation students.

Business (BU)

Business (BU) has a relatively high proportion of resident students and students with a high average index. BU also has reasonably low proportions of first generation students, Pell recipients, minorities, and females.

Although proportionally under-represented, there are negative associations for minority students (compared to non-minority) and first generation students (compared to non-first generation) with first-year retention after controlling for other variables in the model.

It is interesting that there is not a positive association with index and first-year retention among the BU college grouping since BU is one of the only college groups to lack this association. Additionally, BU is the only college grouping to have a negative association for minority students compared to non-minority students.

Engineering (EG)

Engineering (EG) has the lowest proportions of Pell recipients and first generation students and relatively low proportions of minority and female students. EG nearly has the highest average index.

Although proportionally under-represented, there is a negative association for Pell recipients (compared to non-Pell) with first-year retention among the EG cohorts after controlling for other variables in the model.

It is notable that there are not negative associations for minority, female, or first generation students in the EG college grouping. For instance, a first generation student has a similar probability of first-year retention as their non-first generation peer in the EG grouping (all else equal).

Health and Human Sciences- Excluding CM (HHS- no CM)

Health and Human Sciences- excluding CM (HHS- no CM) has the largest proportion of female students, one of the lowest average indexes, and relatively high proportions of minority and resident students.

Typical among all of the college groupings, there are positive associations for residents (compared to non-residents) as well as index with first-year retention and a negative association for first generation students (compared to non-first generation) with first-year retention after controlling for other variables in the model.

Health and Human Sciences- CM

Health and Human Sciences- CM (HHS- CM) has the lowest proportion of female students, the lowest average index, and relatively low proportions of Pell recipients and minority students. HHS- CM has a relatively high proportion of first generation students.

It is interesting that none of the demographic/academic control variables are statistically significant. This is partially due to the smaller number of students in this college grouping.

Intra-University

Intra-University (IU) has relatively large proportions of first generation students, Pell recipients, resident students, and minority students as well as a lower average index.

There are negative associations for first generation students (compared to non-first generation) and Pell recipients (compared to non-Pell recipient) with first-year retention and positive associations for index and residency (compared to non-resident) with first-year retention after controlling for the other variables in the model.

Due to the greater proportional representation of Pell recipients and first generation students among the IU cohorts, the negative associations for these attributes with first-year retention are important.

Liberal Arts- Arts

Liberal Arts- Arts (LA- arts) has the highest proportion of resident students and Pell recipients.

The magnitude of the negative association between Pell recipient status and first-year retention is largest for LA- arts compared to all of the other college groupings. This is of particular importance because LA- arts also has the largest proportional representation of Pell recipients.

Liberal Arts- Humanities

Liberal Arts- Humanities (LA- humanities) has relatively high proportions of females and Pell recipients.

The magnitude of the negative association between first generation status and first-year retention is largest for LA-humanities compared to all of the other college groupings.

Liberal Arts- Social Sciences

Liberal Arts- Social Sciences (LA- social sciences) has relatively high proportions of minority, first generation, and Pell recipient students.

Residency and Index are the only statistically significant positive associations among the LA- social sciences college grouping. Considering the relatively high proportional representation of minority, first generation, and Pell recipient students, it is perceived as a positive result to see an absence of negative associations between these attributes and first-year retention.

Natural Sciences

Natural Sciences (NS) has relatively high proportions of first generation and Pell recipients as well as the highest proportion of minority students. This college grouping also has a relatively high average index.

Typical to some of the other college groupings, NS has negative associations for Pell recipients (compared to non-Pell recipients) and first-generation students (compared to non-first generation) with first-year retention. It is a positive result that there is not a negative association for minority students considering their significant proportional representation among the NS college grouping.

Veterinary Medicine & Biomedical Sciences

Veterinary Medicine and Biomedical Sciences (CVMBS) has the highest average index and comparatively low proportions of Pell recipients and first generation students.

CVMBS stands out because there are not negative associations for Pell recipients (compared to non-Pell) or first generation students (compared to non-first generation) with first year retention. The positive associations for residency status and index with first-year retention are the largest effect sizes among all of the college groupings.

Warner College of Natural Resources

Warner College of Natural Resources (WCNR) has relatively low proportions of first generation and Pell recipient students. WCNR also has one of the lowest proportions of resident students and females.

WCNR does not have negative associations for Pell recipients (compared to non-Pell) or first generation students (compared to non-first generation) with first year retention.