Identifying Students at Risk: Utilizing Survival Analysis to Study Student Athlete Attrition

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Project Background

- University of Minnesota is going through a strategic positioning process
- University goal is to be one of the top three public research universities in the world
- As part of this process, all aspects of the University's functioning are being examined
- Retention and graduation rates have been identified as part of the set of measures that will be used to judge progress toward the strategic goal
- Task force charged with examining "all" aspects related to the academic progress of student athletes

Project Background Continued

- Institutional Research invited to:
  - Collect data and prepare basic profiles on
    - Academic preparation
    - Demographics
    - Academic progress
    - Retention and graduation rates
- Role expanded:
  - More questions arose
    - What are the important predictors
    - How are they related/inter-related to success

Research Question

- Multivariate approach needed to answer the question:
  - “What student-athlete characteristics help predict academic success or departure?”
  - Success defined as retention or graduation by the end of the 2004-2005 academic year

Description of Data Set

- 564 student-athletes
- Entered as first-time, full-time freshmen
- Enrolled at the University of Minnesota-Twin Cities a large, Midwestern, Doctoral-Extensive University
- Three cohorts, entering 1999, 2000, and 2001

Variables in Model

- Dependent variables
  - Retention or graduation by end of 2004-2005
  - Number of credits completed at departure
- Independent variables
  - First term academic performance
  - Academic preparation
  - Athletics status
  - Demographics
  - Financial need

Table 1. Descriptive Statistics of the Sample (N=564)

Variable	Values	Mean	SD	Variable Description (type of variable)
Departure	0-1	0.314	0.464	If not successful at the U (response variable)
Credits	0-203	102.4	40.4	Total credits earned while at the U (timing variable)
Ratio	0-1	0.963	0.118	Ratio of first term credits earned to attempted
C's earned	0-4	0.741	0.886	Number of C grades earned first semester
D's earned	0-2	0.150	0.386	Number of D grades earned first semester
W's earned	0-3	0.050	0.244	Number of W grades earned first semester
ACT Composite	14-36	23.263	4.015	ACT composite score
Remedial	0-3	0.387	0.687	Number of remedial courses taken first semester
Tendered	0-1	0.541	0.499	If tendered (dummy)
Sport Group	0-1	0.709	0.456	If Non-revenue sport group (dummy)
Male	0-1	0.537	0.499	If Male (dummy)
Student of Color	0-1	0.170	0.376	If Black, Hispanic, Asian, Native Am. (dummy)
Reciprocity	0-1	0.174	0.379	If Tuition reciprocity state (dummy)
Non-Reciprocity	0-1	0.236	0.425	If Tuition non-reciprocity state (dummy)
International	0-1	0.034	0.181	If International student (dummy)
Federal Unmet need	$0-$24,194	$4,741	$6,157	Total amount of estimated unmet financial need
Pell	0-1	0.239	0.427	If Pell grant eligible (dummy)
Off-campus Housing	0-1	0.041	0.198	If not living on-campus first term (dummy)

Split-Population Survival Models

- A variety of “event history” or “failure time” models
- Technique developed in sociology to study criminal recidivism, assumes that some cases will not fail (return to prison)
- Also used in biostatistics, economics, and political science
- Simultaneously models likelihood of failure and the timing of failure
- In this context, failure is dropping out of college

Model

- Survival function:

$$S(t \mid F = 1) = \frac{1}{1 + (\lambda t)^{1/\gamma}}$$

- Represents the proportion of initial cohort remaining at a given time given that they are expected to eventually fail
- Lambda (λ) is parameterized as exp(-XB)
- Gamma (γ) determines the shape of the distribution

Table 2. Model fit: Predicted and Actual Student Departure

	Predicted_Outcome		
Actual Departure	**Retained**	**Departed**	**Total**
Retained	**278**	**101**	**379**
Departed	**56**	**116**	**172**
Total	**334**	**217**	**551**

Shape (Gamma)	
Coefficient	.5114
Standard Error	.0459
Z	11.12
Significance	***
P>|Z|	.0000

Model Fit Statistics

- Percent correctly predicted: 71.5%
- Log-likelihood = -1,077.77
- p(chi-square) < .0001

Logit Results

- Most powerful predictors are academic preparation and first-term performance
  - Scoring one standard deviation above the mean on the ACT increases likelihood of success by 11%
  - Earning a single C lowers estimated likelihood of success by 10%
  - Earning a single W lowers estimated likelihood of success by 37%
  - Failure to complete one course successfully lowers estimated likelihood of success by 27%

Logit Results

- Some demographic indicators are also significant
  - Student-athletes from non-reciprocity states are 23% less likely to succeed
  - In a bivariate analysis, student-athletes of color are less likely to be successful, but after controlling for other factors in the model, their estimated likelihood of success is 16% higher than other students

Table 3a. Split-Population Survival Model Parameter Estimate: Logit

Logit (depart)	Coef.	Std Error	z	Sig.	P>|z|
Ratio	-5.7003	1.8063	-3.16	***	0.002
C's earned	0.4245	0.2046	2.07	**	0.038
D's earned	-0.6208	0.4672	-1.33		0.184
W's earned	1.5497	0.5812	2.67	***	0.008
Remedial	1.3247	0.4650	2.85	***	0.004
ACT Composite	-14.7164	6.7375	-2.18	**	0.029
Tendered	0.1546	0.3787	0.41		0.683
Sport Group	-0.4302	0.4110	-1.05		0.295
Male	-0.1573	0.3802	-0.41		0.679
Student of Color	-0.9631	0.5267	-1.83	*	0.067
Reciprocity	0.1224	0.5704	0.21		0.830
Non-Reciprocity	0.9348	0.4616	2.02	**	0.043
International	2.0597	1.7109	1.20		0.229
Federal Unmet Need	0.1452	0.0819	1.77	*	0.076
Pell	-0.2625	0.4517	-0.58		0.561
Off-Campus Housing	-1.6218	0.8458	-1.92	*	0.055
Constant	8.1469	3.0103	2.71		0.007

Table 4. Predicted Retention Rates for Alternative Values of Each Variable Holding All Other Variables at Baseline Values

Logit (depart)	Baseline	Alternative	Retention	Change
Ratio	1.0	0.8	43%	-27%
C's earned	0	1	61%	-10%
D's earned	0	1	82%	11%
W's earned	0	1	34%	-37%
Remedial	0	1	39%	-32%
ACT Composite	23	27	81%	11%
Tendered	0	1	67%	-3%
Sport Group	0	1	79%	8%
Male	0	1	74%	3%
Student of Color	0	1	86%	16%
Reciprocity	0	1	68%	-3%
Non-Reciprocity	0	1	48%	-22%
International	0	1	23%	-47%
Federal Unmet Need	$500	$2,500	64%	-6%
Pell	0	1	76%	5%
Off-Campus Housing	0	1	92%	22%
		Baseline:	70%	0%

Duration Results

- First-term academic performance again has the strongest impact
  - For a single D earned, probability of success after 30 credits drops from 85% to 67%, and after 90 credits from 40% to 19%
  - For a single W earned, probability of success after 30 credits drops from 85% to 60%, and after 90 credits from 40% to 15%

Table 3b. Split-Population Survival Model Parameter Estimate: Log-Logistic Duration

Duration (credits)	Coef.	Std Error	z	Sig.	P>|z|
Ratio	1.2664	0.5270	2.40	**	0.016
C's earned	0.0018	0.0909	0.02		0.984
D's earned	-0.5393	0.1869	-2.89	***	0.004
W's earned	-0.6827	0.2129	-3.21	***	0.001
Remedial	0.2123	0.1166	1.82	*	0.069
ACT Composite	-5.9107	3.3046	-1.79	*	0.074
Tendered	0.0185	0.2110	0.09		0.930
Sport Group	0.1503	0.2091	0.72		0.472
Male	-0.1605	0.2005	-0.80		0.423
Student of Color	-0.5720	0.2302	-2.48	**	0.013
Reciprocity	0.1881	0.3347	0.56		0.574
Non-Reciprocity	0.2334	0.2059	1.13		0.257
International	-0.0443	0.6375	-0.07		0.945
Federal Unmet Need	-0.0456	0.0311	-1.47		0.142
Pell	0.1282	0.2133	0.60		0.548
Off-Campus Housing	-0.7673	0.4186	-1.83	*	0.067
Constant	4.4114	1.1301	3.90		-

Table 5. Predicted Survivor Function for Alterative Values of Each Variable Holding All Other Variables at Baseline Values

			Survivor Function			
Duration (credits)	**Baseline**	**Alternative**	**30 credits**	**60 credits**	**90 credits**	**120 credits**
Ratio	1.0	0.8	78%	47%	29%	19%
C's earned	0	1	85%	60%	40%	28%
D's earned	0	1	67%	34%	19%	12%
W's earned	0	1	60%	28%	15%	9%
Remedial	0	1	90%	69%	50%	37%
ACT Composite	23	27	78%	48%	30%	19%
Tendered	0	1	86%	61%	41%	28%
Sport Group	0	1	89%	67%	47%	34%
Male	0	1	81%	52%	33%	22%
Student of Color	0	1	65%	33%	18%	11%
Reciprocity	0	1	89%	68%	49%	36%
Non-Reciprocity	0	1	90%	70%	51%	38%
International	0	1	84%	58%	38%	26%
Federal Unmet Need	$500	$2,500	83%	55%	36%	24%
Pell	0	1	88%	66%	46%	33%
Off-Campus Housing	0	1	56%	25%	13%	8%
		Baseline:	85%	60%	40%	28%

Policy Implications

- Academic performance in the first term is critical
- The University of Minnesota has in place a program to issue mid-term alerts to freshmen who are struggling in courses
- This program, which began after the cohorts in this study were admitted, affords the institution an opportunity to identify and reach out to students who are struggling before they fail or withdraw from classes

Questions for future research

- Analysis is being done on full student body, which should help identify issues that are distinct to student-athletes
- Results suggest that some departing students are in good academic standing, suggesting they may be transferring to another institution rather than dropping out
- Adding more extensive recent data may help in identifying issues related to social integration

Questions?

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