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Dropping in on dropouts: an analysis of withdrawals from the University of Northern Iowa

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DROPPING IN ON DROPOUTS: AN ANALYSIS OF WITHDRAWALS FROM THE UNIVERSITY OF NORTHERN IOWA

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Dropping in on Dropouts: An Analysis of Withdrawals from the University of Northern Iowa

The number of students enrolled at a university has a direct effect on its budget. Enrollment determines the class sizes and courses provided, number of professors required to teach scheduled classes, classrooms and supplies needed, and the total expenditures on the costs of instruction (e.g. campus utilities, janitorial services, etc.). Consequently, universities need to accurately predict enrollment to adequately budget. Research predominantly predicts enrollment by modeling the number of withdrawals because the students that re-enroll are those that do not dropout.

A university needs to maintain enrollment to keep its budget relatively constant each year. Universities can maintain enrollment by either recruiting new students or retaining current students. Retaining current students requires fewer resources, making retention the more cost effective strategy. To increase retention a university must know the factors that lead to withdrawal. However, current withdrawal studies focus on aggregate enrollment. At the University of Northern Iowa (UNI), students who have decided to withdraw from classes during the semester complete a form that asks for their reason of withdrawal. The Enrollment Management Department at UNI could use the student responses to identify the causes of concern and create strategies to decrease the number of withdrawals and subsequently increase enrollment.

One method of identifying the popular causes of withdrawal is to conduct a multiple decrement analysis. This type of analysis calculates the probability of decrement, or withdrawal from a group, for each reason listed on the exit form. This paper attempted to conduct a multiple decrement analysis to provide probabilities that a student leaves the University due to a particular cause, given her credit classification. Current data does not allow such a multiple decrement analysis, but one would give the Enrollment Management Department the ability to identify areas of concern as well as predictions of dropouts and enrollment.

Due to the limited availability of data, this paper was only able to analyze total withdrawals. This does not allow the University to identify significant causes of withdrawal, but it does allow the University to predict total withdrawals and enrollment. The results of this analysis may also assist the Enrollment Management Department with questions such as how many students should be admitted for each student group to reach a desired steady state of enrollment and how many students should be admitted to reach a desired number of undergraduates who complete their degrees in four years. This analysis gives the Enrollment Management Department an even better understanding of the issues related to admissions, and provides suggestions to identify the causes of why students leave the University to help improve the enrollment process.

Literature Review

Research regarding enrollment management fell into two categories: (1) how to predict aggregate future enrollment or (2) how to identify psychological and sociological characteristics that may cause a student to dropout.

How to Predict Aggregate Future Enrollment

A dominant method for predicting enrollment is Markov Chains (Schroeder, 1973). Markov Chains use current events to predict immediate future results, without exploring the underlying causes for such phenomena (Norris, 1997). As such, if one wanted to predict enrollment for Fall 2016, she would rely only on the Fall 2015 data. While Markov Chains adequately predict enrollment, they ignore long-term historical data. In addition, Markov Chains that focus on short term events may be ill equipped to recognize long-term trends or historical factors when assessing future student enrollment. On the other hand, longitudinal models, such as a multiple decrement analysis, include historical data and follow a group of students through time. The methodology section of this paper discusses how student enrollment can be studied using a multiple decrement analysis.

Glynn and Miller (2001) proposed an alternative longitudinal model that classifies students by the number of semesters completed at the end of a semester. As such, incoming freshman were in their first semester and the spring semester of a four year program was the eighth semester. When students transferred to the studied university, the researcher placed the transfer students in the group that matched the students' expected graduation date. However, if a student dropped out and then returned to the same university, she returned to the group she was in when she dropped out, regardless of whether or not she would graduate with the majority of the students in that group.

The focus of Glynn and Miller's (2001) model was following the students' transitions from semester to semester. An enrolled student could have dropped out, advanced to the next semester, or graduated. Additionally, the enrolled students were new transfers, returning dropouts, or students that were enrolled the previous semester. Classifying the students this way allowed the researcher to create a frequency table that showed both where the students came from and where they went the next semester. Glynn and Miller (2001) suggested creating this table for each class of students and then aggregating all classes in the study period to identify trends. This model showed the transitions students make while at a university which allowed universities to identify withdrawal probabilities relative to student progress. However, much like other studies, Glynn and Miller (2001) did not provide a means of identifying significant causes of withdrawal.

A third model for predicting enrollment was the work-load method (Marshall, K. T. & Oliver, R. M., 1970). This style of model utilized the fact that all students have a certain amount of work to complete before graduating and that their current amount of completed work was the most relevant factor in predicting enrollment. Marshall and Oliver (1970) applied this model by tracking each class of students without allowing new transfers or re-entry. Their results indicated that a large number of students leave after the eighth semester. Marshall and Oliver (1970) argued that this pattern implied a constant amount of work, namely eight semesters, which students must complete to graduate. Applying this model allowed universities to calculate probabilities that a student returns the next semester and the probability that a student eventually graduates. The probability of returning can be applied to predict future enrollment for a given admitted number. This number is not as accurate as other models, as it ignores new transfers and returning dropout students from the enrollment counts.

How to Identify Psychological and Sociological Characteristics

As discussed, research that predicted enrollment only analyzed total withdrawals. Research that did separate withdrawals focused on the psychological and sociological characteristics of the withdrawing students rather than their reason for withdrawing. Tinto's Student Integration Theory (1975) argued that a student's commitment to obtaining a degree and staying at a university for social aspects were the main drivers of whether or not a student dropped out (Cabrera, A. F., Nora, A., & Castaneda, M. B., 1993). According to this theory, one must measure a student's commitment levels to predict dropouts. Popular predictors included sex, race, high school GPA, social status, individual values, and time spent on nonacademic activities (Tinto, 1975). It is widely accepted that dropout behavior is negatively correlated with both social status and high school GPA. Additionally, researchers believe that an optimal amount of time spent on nonacademic activities exists to make a student committed to remaining at the university without becoming over involved and failing (Tinto, 1975). One additional social aspect that researchers related to students dropping out was the prestige students assign to an institution based on the perceived quality of their education. Tinto's theory suggests that researchers may investigate these indicators of commitment levels when attempting to identify why students withdraw from universities.

Bean's Student Attrition Model (1985) provided a second theoretical model to identify which students were more likely to dropout. Cabrera et al. (1993) explained that, "the Student Attrition Model presumes that behavioral intentions are shaped by a process whereby beliefs shape attitudes, and attitudes, in turn, influence behavioral intents" (p. 125). According to Bean's theory, the student's beliefs and attitudes predicted whether or not a student dropped out. These beliefs and attitudes were affected by both a student's experiences prior to, and while attending, the university. Surprisingly, Bean's model ignored student ability and only used non-intellectual factors to predict dropout behavior.

Past literature regarding enrollment allowed universities to predict aggregate enrollment and to identify psychological/sociological characteristics that may lead to withdrawal. It did not, however, allow universities to identify significant causes of withdrawal. To increase retention, universities must know why students are leaving. Therefore, research needs to be conducted to help universities identify popular causes of withdrawal.

Methodology

This study used a multiple decrement analysis, an actuarial model that studies the causes for an individual to leave a group. This actuarial model is most popular in the life insurance industry to provide probabilities of death for certain causes based on the insured's age. The results are displayed in table form with the causes of death serving as the titles of the columns and the individual's age as the titles of the rows. Within each cell of the table is the probability of dying from the column's cause at the row's age. A multiple decrement analysis provides life insurers with the information they require to adequately price their products and remain solvent after paying life insurance benefits.

This paper sought to apply a multiple decrement analysis to students enrolled at the University of Northern Iowa. When a student leaves the University during the semester, she is required to complete a form with the Registrar. This form is in Appendix A. A portion of this form asks the student to explain why she is leaving the University. The Registrar then records the student's response as one of the following: (1) Attend Another College, (2) Death, (3) Financial, (4) Health/Medical, (5) Military, (6) Not Continuing Education, or (7) Other. The Registrar began collecting this information Fall 2011, and as such, comparable data currently exists for nine semesters. Following Institutional Review Board requirements, the Registrar provided the aggregate number of withdrawals for each reason separated by semester and the credit classification of the student. The credit classification definitions are in Table 1. To calculate probabilities of withdrawal, the Registrar also provided enrollment data with the same credit classification break downs as the withdrawal data. Applying the multiple decrement analysis methodology would produce a table with the seven causes of withdrawal as the titles of the columns and the student credit classifications as the titles of the rows.

Table 1: Student Credit Classifications

Classification (x)	Description
Freshman (1)	Undergraduate with 30 or less credit hours
Sophomore (2)	Undergraduate with more than 30 but less than 60 hours
Junior (3)	Undergraduate with more than 60 but less than 90 hours
Senior (4)	Undergraduate with more than 90 hours without an undergraduate degree
1st Year Graduate (G1)	Undergraduate degree and less than 24 graduate credits

2nd Year Graduate (G2)	Undergraduate degree and more than 24 but under 48 graduate credits
Upper Level Graduate (G3)	Undergraduate degree and more than 48 graduate credits

Notation and Theory:

Before discussing the theory of multiple decrement analysis, some basic notation must be defined. The notation and equations used in this paper closely follow Jordan's *Life Contingencies* (1967).

x is the age of the individual in the group

l_x is the number of x aged individuals

$d_x^{(T)}$ is the total number of individuals that leave the group at age x

$d_x^{(k)}$ is the number of individuals that leave the group at age x from cause k

For a multiple decrement analysis, the researcher studies a closed group of individuals. A closed group is one where no new individuals enter the group and once removed, an individual may not re-enter the group (Jordan, 1967). As such, the largest value of l_x happens at the youngest age, x_0. During age x_0, $d_{x_0}^{(T)}$ individuals leave the group. This value can be broken down into n causes such that the total number of withdrawals equals the sum of withdrawals for each cause of withdrawal, or

$$d_x^{(T)} = \sum_{k=1}^{n} d_x^{(k)}.$$

Because there is a closed group, if $d_{x_0}^{(T)}$ leave the group in the first year, then the number that remain in the group the second year is the difference between the number in the group during the first year less those that leave during the year, or

$$l_{x_0+1} = l_{x_0} - d_{x_0}^{(T)}.$$

For example, if a group begins with 100 individuals aged 20 and seven members leave between ages 20 and 21, then $l_{20} = 100$, $d_{20}^{(T)} = 7$, and $l_{21} = 100 - 7 = 93$. If it is known that two individuals leave because of cause 1, three due to cause 2, and two from cause 3, then

$$d_{20}^{(1)} = 2 \qquad d_{20}^{(2)} = 3 \qquad d_{20}^{(3)} = 2$$

$$d_{20}^{(T)} = \sum_{k=1}^{3} d_{20}^{(k)} = 2 + 3 + 2 = 7.$$

The number of people in the group and the counts of people that leave each year for each cause are typically depicted in table form:

Table 2: Number of Withdrawals Table Layout

Age	Number of x aged individuals	Number of withdrawals from		
		Cause 1	Cause 2	Any Cause
x_0	l_x	$d_{x_0}^{(1)}$	$d_{x_0}^{(2)}$	$d_{x_0}^{(T)}$
$x_0 + 1$	l_{x_0+1}	$d_{x_0+1}^{(1)}$	$d_{x_0+1}^{(2)}$	$d_{x_0+1}^{(T)}$

More interesting results are derived from the following probabilities:

$q_x^{(k)}$ is the probability of an x aged individual leaving the group from cause k

$q_x^{(T)}$ is the probability of an x aged individual leaving the group for any cause

$p_x^{(T)}$ is the probability of an x aged individual staying the group

${}_tp_x^{(T)}$ is the probability of an x aged individual remaining in the group for t years

Consistent with probability theory, the probability of an individual leaving the group is the total number that leave divided by the total number in the group at the start of the period such that

$$q_x^{(T)} = \frac{d_x^{(T)}}{l_x}.$$

Analogously, the probability of leaving for cause k is the number of withdrawals due to cause k divided by the total number in the group implying that

$$q_x^{(k)} = \frac{d_x^{(k)}}{l_x}.$$

The denominator of both of these functions is l_x making it possible to add the probabilities of each cause of withdrawal to get the total probability of withdrawal:

$$q_x^{(T)} = \sum_{k=1}^{n} q_x^{(k)}$$

There are only two options for each individual in the group: withdraw or stay. As such, the probability of remaining is one minus the probability of withdrawing or

$$p_x^{(T)} = 1 - q_x^{(T)}.$$

The probability of remaining can also be computed directly from the number of individuals in the group at ages x and $x + 1$:

$$p_x^{(T)} = 1 - q_x^{(T)} = 1 - \frac{d_x^{(T)}}{l_x} = 1 - \frac{l_x - l_{x+1}}{l_x} = \frac{l_{x+1}}{l_x}.$$

The same concept can be extended for t years:

$${}_t p_x^{(T)} = \frac{l_{x+n}}{l_x}$$

The probability of remaining for t years may also be calculated from each year's probability of remaining as follows:

$$ {}_{t}p_{x}^{(T)} = p_{x}^{(T)} * p_{x+1}^{(T)} * \dots * p_{x+n}^{(T)} = \prod_{i=0}^{t} p_{i}^{(T)}. $$

With the help of these formulas, Table 2 can be transformed into Table 3 which provides the probabilities of withdrawal.

Table 3: Probability of Withdrawals Table

Age	**Probability of withdrawal from**		
	Cause 1	**Cause 2**	**Any Cause**
x_0	$q_{x_0}^{(1)}$	$q_{x_0}^{(2)}$	$q_{x_0}^{(T)}$
$x_0 + 1$	$q_{x_0+1}^{(1)}$	$q_{x_0+1}^{(2)}$	$q_{x_0+1}^{(T)}$

Application to UNI Enrollment:

To build a multiple decrement analysis table using UNI enrollment a slight deviation from the true theory is made as enrollment is not a closed group; new students transfer to the University each semester and those that withdraw are allowed to re-enroll. To compensate for this, an open-group methodology was applied. An open-group multiple decrement analysis treats each semester's withdrawal data as a cross-section of the complete longitudinal model. If enrollment, transfers, and withdrawals are constant, the information from each semester serves as a picture of what would be seen if a researcher followed a closed group. From these snapshots of withdrawal data, the researcher can build the multiple decrement table on the next page using the formulas discussed above.

Table 4: UNI Multiple Decrement Table Format

Credit Classification	Probability of withdrawal from:								Probability of continuing one semester
	Attend Another College (c)	Death (d)	Financial (f)	Health/ Medical (h)	Military (m)	Not Continuing Education (n)	Other (o)	TOTAL (T)	
Fall Freshman (F1)	$q_{F1}^{(c)}$	$q_{F1}^{(d)}$	$q_{F1}^{(f)}$	$q_{F1}^{(h)}$	$q_{F1}^{(m)}$	$q_{F1}^{(n)}$	$q_{F1}^{(o)}$	$q_{F1}^{(T)}$	$p_{F1}^{(T)} = 1 - q_{F1}^{(T)}$
Spring Freshman (S1)	$q_{S1}^{(c)}$	$q_{S1}^{(d)}$	$q_{S1}^{(f)}$	$q_{S1}^{(h)}$	$q_{S1}^{(m)}$	$q_{S1}^{(n)}$	$q_{S1}^{(o)}$	$q_{S1}^{(T)}$	$p_{S1}^{(T)} = 1 - q_{S1}^{(T)}$
Fall Sophomore (F2)	$q_{F2}^{(c)}$	$q_{F2}^{(d)}$	$q_{F2}^{(f)}$	$q_{F2}^{(h)}$	$q_{F2}^{(m)}$	$q_{F2}^{(n)}$	$q_{F2}^{(o)}$	$q_{F2}^{(T)}$	$p_{F2}^{(T)} = 1 - q_{F2}^{(T)}$
Spring Sophomore (S2)	$q_{S2}^{(c)}$	$q_{S2}^{(d)}$	$q_{S2}^{(f)}$	$q_{S2}^{(h)}$	$q_{S2}^{(m)}$	$q_{S2}^{(n)}$	$q_{S2}^{(o)}$	$q_{S2}^{(T)}$	$p_{S2}^{(T)} = 1 - q_{S2}^{(T)}$
Fall Junior (F3)	$q_{F3}^{(c)}$	$q_{F3}^{(d)}$	$q_{F3}^{(f)}$	$q_{F3}^{(h)}$	$q_{F3}^{(m)}$	$q_{F3}^{(n)}$	$q_{F3}^{(o)}$	$q_{F3}^{(T)}$	$p_{F3}^{(T)} = 1 - q_{F3}^{(T)}$
Spring Junior (S3)	$q_{S3}^{(c)}$	$q_{S3}^{(d)}$	$q_{S3}^{(f)}$	$q_{S3}^{(h)}$	$q_{S3}^{(m)}$	$q_{S3}^{(n)}$	$q_{S3}^{(o)}$	$q_{S3}^{(T)}$	$p_{S3}^{(T)} = 1 - q_{S3}^{(T)}$
Fall Senior (F4)	$q_{F4}^{(c)}$	$q_{F4}^{(d)}$	$q_{F4}^{(f)}$	$q_{F4}^{(h)}$	$q_{F4}^{(m)}$	$q_{F4}^{(n)}$	$q_{F4}^{(o)}$	$q_{F4}^{(T)}$	$p_{F4}^{(T)} = 1 - q_{F4}^{(T)}$
Spring Senior (S4)	$q_{S4}^{(c)}$	$q_{S4}^{(d)}$	$q_{S4}^{(f)}$	$q_{S4}^{(h)}$	$q_{S4}^{(m)}$	$q_{S4}^{(n)}$	$q_{S4}^{(o)}$	$q_{S4}^{(T)}$	$p_{S4}^{(T)} = 1 - q_{S4}^{(T)}$
Fall 1st Year Graduate (FG1)	$q_{FG1}^{(c)}$	$q_{FG1}^{(d)}$	$q_{FG1}^{(f)}$	$q_{FG1}^{(h)}$	$q_{FG1}^{(m)}$	$q_{FG1}^{(n)}$	$q_{FG1}^{(o)}$	$q_{FG1}^{(T)}$	$p_{FG1}^{(T)} = 1 - q_{FG1}^{(T)}$
Spring 1st Year Graduate (SG1)	$q_{SG1}^{(c)}$	$q_{SG1}^{(d)}$	$q_{SG1}^{(f)}$	$q_{SG1}^{(h)}$	$q_{SG1}^{(m)}$	$q_{SG1}^{(n)}$	$q_{SG1}^{(o)}$	$q_{SG1}^{(T)}$	$p_{SG1}^{(T)} = 1 - q_{SG1}^{(T)}$
Fall 2nd Year Graduate (FG2)	$q_{FG2}^{(c)}$	$q_{FG2}^{(d)}$	$q_{FG2}^{(f)}$	$q_{FG2}^{(h)}$	$q_{FG2}^{(m)}$	$q_{FG2}^{(n)}$	$q_{FG2}^{(o)}$	$q_{FG2}^{(T)}$	$p_{FG2}^{(T)} = 1 - q_{FG2}^{(T)}$
Spring 2nd Year Graduate (SG2)	$q_{SG2}^{(c)}$	$q_{SG2}^{(d)}$	$q_{SG2}^{(f)}$	$q_{SG2}^{(h)}$	$q_{SG2}^{(m)}$	$q_{SG2}^{(n)}$	$q_{SG2}^{(o)}$	$q_{SG2}^{(T)}$	$p_{SG2}^{(T)} = 1 - q_{SG2}^{(T)}$
Fall Upper Level Graduate (FG3)	$q_{FG3}^{(c)}$	$q_{FG3}^{(d)}$	$q_{FG3}^{(f)}$	$q_{FG3}^{(h)}$	$q_{FG3}^{(m)}$	$q_{FG3}^{(n)}$	$q_{FG3}^{(o)}$	$q_{FG3}^{(T)}$	$p_{FG3}^{(T)} = 1 - q_{FG3}^{(T)}$
Spring Upper Level Graduate (SG3)	$q_{SG3}^{(c)}$	$q_{SG3}^{(d)}$	$q_{SG3}^{(f)}$	$q_{SG3}^{(h)}$	$q_{SG3}^{(m)}$	$q_{SG3}^{(n)}$	$q_{SG3}^{(o)}$	$q_{SG3}^{(T)}$	$p_{SG3}^{(T)} = 1 - q_{SG3}^{(T)}$

The researcher can use Table 4 to create Table 5.

Table 5: Formulas for Probabilities of Continuing for Students that Enter in the Fall

Credit Classification (i)	Probability of Remaining:			
	One Year $_1p_i^{(T)}$	**Two Years** $_2p_i^{(T)}$	**Three Years** $_3p_i^{(T)}$	**Four Years** $_4p_i^{(T)}$
Freshmen (1)	$_1p_1^{(T)} = p_{F1}^{(T)} * p_{S1}^{(T)}$	$_2p_1^{(T)} = {_1p_1^{(T)}} * {_1p_2^{(T)}}$	$_3p_1^{(T)} = {_2p_1^{(T)}} * {_1p_3^{(T)}}$	$_4p_1^{(T)} = {_3p_1^{(T)}} * {_1p_4^{(T)}}$
Sophomore (2)	$_1p_2^{(T)} = p_{F2}^{(T)} * p_{S2}^{(T)}$	$_2p_2^{(T)} = {_1p_2^{(T)}} * {_1p_3^{(T)}}$	$_3p_2^{(T)} = {_2p_2^{(T)}} * {_1p_4^{(T)}}$	
Junior (3)	$_1p_3^{(T)} = p_{F3}^{(T)} * p_{S3}^{(T)}$	$_2p_3^{(T)} = {_1p_3^{(T)}} * {_1p_4^{(T)}}$		
Senior (4)	$_1p_4^{(T)} = p_{F4}^{(T)} * p_{S4}^{(T)}$			
1st Year Graduate (G1)	$_1p_{G1}^{(T)} = p_{FG1}^{(T)} * p_{SG1}^{(T)}$	$_2p_{G1}^{(T)} = {_1p_{G1}^{(T)}} * {_1p_{G2}^{(T)}}$	$_3p_{G1}^{(T)} = {_2p_{G1}^{(T)}} * {_1p_{G3}^{(T)}}$	
2nd Year Graduate (G2)	$_1p_{G2}^{(T)} = p_{FG2}^{(T)} * p_{SG2}^{(T)}$	$_2p_{G2}^{(T)} = {_1p_{G2}^{(T)}} * {_1p_{G3}^{(T)}}$		
Upper Level Graduate (G3)	$_1p_{G3}^{(T)} = p_{FG3}^{(T)} * p_{SG3}^{(T)}$			

Table 5 contains the probability that for each credit classification a student enrolled in the fall remains for one, two, three, or four years. Table 5 assists with the answers to both research questions: how many students need to be admitted to reach a desired steady state of enrollment and how many students need to be admitted to reach a desired number of graduates each year?

Steady State of Enrollment

To answer how many students need to be admitted to reach a desired steady state of enrollment it must be noted that enrollment at the start of each year is the sum of the number of freshman, sophomores, juniors, and seniors, or

$$l_1 + l_2 + l_3 + l_4.$$

As previously defined,

$$p_x^{(T)} = \frac{l_{x+1}}{l_x}$$

or,

$$p_x^{(T)} * l_x = l_{x+1}.$$

Additionally,

$$_t p_x^{(T)} = \prod_{i=0}^{t} p_i^{(T)}.$$

Using these facts, the enrollment total can be rewritten in terms of initial enrollment and the probabilities of staying at the University.

$$l_1 + l_2 + l_3 + l_4$$

$$= l_1 + l_2 + l_3 + p_3^{(T)} l_3$$

$$= l_1 + l_2 + \left(p_2^{(T)} * l_2\right) + p_3^{(T)}\left(p_2^{(T)} * l_2\right)$$

$$= l_1 + \left(p_1^{(T)} * l_1\right) + p_2^{(T)}\left(p_1^{(T)} * l_1\right) + p_3^{(T)} p_2^{(T)}\left(p_1^{(T)} * l_1\right)$$

$$= l_1 + \left(p_1^{(T)} * l_1\right) + \left({}_2p_1^{(T)} * l_1\right) + \left({}_3p_1^{(T)} * l_1\right)$$

$$= l_1 * \left(1 + p_1^{(T)} + {}_2p_1^{(T)} + {}_3p_1^{(T)}\right)$$

Adding transfer students and other new students to the group, enrollment is more realistically expressed as

$$= \left[l_1 * \left(1 + p_1^{(T)} + {}_2p_1^{(T)} + {}_3p_1^{(T)}\right)\right] + NonFreshmen\ Entrants.$$

The graduate level parallel, assuming three years to complete a program, is as follows:

$$\left[l_{G1} * \left(1 + p_{G1}^{(T)} + {}_2p_{G1}^{(T)}\right)\right] + NonG1\ Entrants.$$

Desired Number of Graduates

It is also possible to answer the second research question: how many students need to be admitted to reach a desired number of graduates each year? The number of graduates is equivalent to the number of seniors that do not withdraw, or

$$p_4^{(T)} * l_4.$$

By assuming a closed group, this formula can be rewritten in terms of the freshmen admitted.

$$p_4^{(T)} * l_4$$

$$= p_4^{(T)}\left(p_3^{(T)} * l_3\right)$$

$$= p_4^{(T)} p_3^{(T)}\left(p_2^{(T)} * l_2\right)$$

$$= p_4^{(T)} p_3^{(T)} p_2^{(T)}\left(p_1^{(T)} * l_1\right)$$

$$= {}_4p_1^{(T)} * l_1$$

Therefore, the number of students that graduate is the number of Freshmen admitted times the probability that they remain at the University for four years. Analogously, the probability that a student who transfers in as a Sophomore graduates would be the probability that she remains at the University for three years. With this thought in mind, transfer students can be added to the equation, resulting in the following complex expression:

$$\left({}_4p_1^{(T)} * l_1\right) + \left({}_3p_2^{(T)} * l_{2_{NEW}}\right) + \left({}_2p_3^{(T)} * l_{3_{NEW}}\right) + \left({}_1p_4^{(T)} * l_{4_{NEW}}\right).$$

For graduate students, the formula is

$$\left({}_3p_{G1}^{(T)} * l_{G1}\right) + \left({}_2p_{G2}^{(T)} * l_{G2_{NEW}}\right) + \left({}_1p_{G3}^{(T)} * l_{G3_{NEW}}\right).$$

Results

Unfortunately, the data provided by the Registrar did not allow for an analysis of the causes as explained in the methodology section. Seventy-three percent of the students that withdrew from the University selected Other as their reason for withdrawing resulting in most of the causes having no withdrawals per credit classification and semester. As such, the only possibility was to study total withdrawals from the University and leave an examination of causes to future research. Suggestions for how to analyze causes of withdrawal are in the discussion section.

Once the study was reduced to only total withdrawals, it was conducted on data older than the Fall 2011 semester because total numbers were not affected by the installment of the withdrawal form. The researcher submitted a second data request asking for the last 10 years of enrollment and withdrawal aggregates. This included the Spring 2006 to Fall 2015 semesters. The first nine years were used to calculate probabilities of withdrawal while the Spring 2015 and Fall 2015 semesters were reserved for model verification as a hold out sample. The first step of the analysis looked at the last nine semesters of enrollment and withdrawals to determine whether or not the data was steady and if the researcher could apply the open-group method. While there has been variation in these numbers, they appear to follow a cyclical pattern; there tends to be three years of above average numbers followed by three years of below average and so on. The relatively steady nature of the historical data allowed the open-group method to be applied to the withdrawal data. The results of this analysis are in Table 6.

Table 6: UNI Total Withdrawals Probabilities and Prediction for Spring and Fall 2015

Student Classification	Probability of Withdrawal	Most Recent Enrollment	Estimated Withdrawals	Actual Withdrawals	Difference
Fall Freshmen	0.00969	2134	20.67191	33	-12.3281
Spring Freshmen	0.01063	1296	13.77332	16	-2.22668
Fall Sophomores	0.00981	1896	18.60527	21	-2.39473
Spring Sophomores	0.00909	1729	15.72182	24	-8.27818
Fall Juniors	0.01225	2504	30.66667	27	3.666667
Spring Juniors	0.01154	2346	27.06387	29	-1.93613
Fall Seniors	0.00949	3375	32.03418	22	10.03418
Spring Seniors	0.00753	3661	27.58258	34	-6.41742
Fall 1st Year Graduates	0.01434	1146	16.43827	17	-0.56173
Spring 1st Year Graduates	0.01478	924	13.65345	12	1.653448
Fall 2nd Year Graduates	0.00358	652	2.332538	3	-0.66746
Spring 2nd Year Graduates	0.00280	784	2.196802	2	0.196802
Fall Upper Level Graduates	0.00558	231	1.289302	0	1.289302
Spring Upper Level Graduates	0.00453	252	1.142151	1	0.142151

It is surprising that the probabilities of withdrawal at the Sophomore and Junior levels are not lower than that of Freshmen. It was expected that the probability of withdrawal would decrease as the student completed coursework; as a student ages it becomes more difficult to transfer and still graduate on time. A possible explanation for this phenomenon is transfer students. It might be that transfer students have a more difficult time adjusting from their previous university and struggle more at the University than those who began as Freshmen.

To assess the accuracy of Table 6, the researcher calculated a 95 percent confidence interval of the average difference between the predicted and actual withdrawal numbers, assuming a normal distribution for withdrawals. This confidence interval was [-4.34, 1.80] implying that, with 95 percent confidence, there is no statistically significant difference between the number of withdrawals the model predicts and the actual number of withdrawals for the Spring and Fall 2015 semesters because zero is included in the interval.

Application of Results to Research Questions:

With the probabilities of withdrawal calculated it is possible to answer the two research questions using Table 7 which the researcher constructed using the formulas in Table 5.

Table 7: Probabilities of Continuing for Students that Enter in the Fall

Credit Classification (i)	**Probability of Remaining:**			
	One Year $_1p_i^{(T)}$	**Two Years** $_2p_i^{(T)}$	**Three Years** $_3p_i^{(T)}$	**Four Years** $_4p_i^{(T)}$
Freshmen (1)	0.97978	0.96135	0.93862	0.92271
Sophomore (2)	0.98119	0.95799	0.94175	
Junior (3)	0.97635	0.95980		
Senior (4)	0.98305			
1st Year Graduate (G1)	0.97109	0.96491	0.95518	
2nd Year Graduate (G2)	0.993630	0.98361		
Upper Level Graduate Hours (G3)	0.989915			

Steady State of Enrollment

As previously discussed, the enrollment at the start of each year, if the University did not allow transfers, would be expressed as

$$l_1 * \left(1 + p_1^{(T)} + {}_2p_1^{(T)} + {}_3p_1^{(T)}\right).$$

Filling in this equation with the information from Table 7 it may also be expressed as

$$3.87975 * l_1.$$

Therefore the Enrollment Management Department may use a factor of 3.87975 when enrolling students to the University; if they wish to obtain a steady state of enrollment at 13,000 students, for example, then they should consistently accept the number of students that would lead to 3,350 (13,000/3.87975) new Freshmen each fall semester. Before applying this result, the Enrollment Management Department would need to conduct a separate analysis to determine how many students that were accepted actually chose to attend the University. Once the Enrollment

Management Department knows the ratio, α, of accepted students who enroll they can adjust the previous factor to $\alpha * 3.87975$.

Allowing transfer and other new students, this formula changes to

$$(3.87975 * l_1) + NonFreshmen\ Entrants.$$

This is a painless transition; if the University wants to achieve a steady state of 13,000 they can allow 1,000 new Non-Freshmen and then accept the number of Freshmen that would lead to 3,092 (12,000/3.87975) students enrolling in the Fall semester.

For the graduate level the equation is

$$\left[l_{G1} * \left(1 + p_{G1}^{(T)} + {}_2p_{G1}^{(T)}\right)\right] + NonG1\ Entrants$$

$$= (2.9356 * l_{G1}) + NonG1\ Entrants.$$

Desired Number of Graduates

Assuming students graduate in four years and that the University did not allow transfer students, the number of graduates was previously expressed as

$${}_4p_1^{(T)} * l_1.$$

Using the information in Table 7 this equation becomes

$$0.92271 * l_1.$$

From this information, the University can expect 92.271 percent of students that enroll as Freshmen in the fall to graduate within four years. If the University wants to have 3000 students graduate each year they would need to have approximately 3250 students enroll in the fall as Freshmen each year.

While this simple explanation is convenient, the University does allow transfer students, so the number of graduates is realistically expressed as

$$\left({}_4p_1^{(T)} * l_1\right) + \left({}_3p_2^{(T)} * l_{2_{NEW}}\right) + \left({}_2p_3^{(T)} * l_{3_{NEW}}\right) + \left({}_1p_4^{(T)} * l_{4_{NEW}}\right)$$

$$= (0.92271 * l_1) + \left(0.94175 * l_{2_{NEW}}\right) + \left(0.95980 * l_{3_{NEW}}\right) + \left(0.98305 * l_{4_{NEW}}\right).$$

This formula does not allow as explicit interpretations as the previous one; there are many ways for the University to obtain 3000 graduates based on the number of students admitted at each credit classification. For example, if the University admitted 900 Non-Freshmen, 300 at each level, then they would expect approximately 865 of these Non-Freshmen to eventually graduate. If the University were still hoping to graduate 3000 students each year, then they would need approximately 2315 Freshmen to enroll in the fall.

At the graduate level allowing transfer students, the number of graduates is

$$\left({}_3p_{G1}^{(T)} * l_{G1}\right) + \left({}_2p_{G2}^{(T)} * l_{G2_{NEW}}\right) + \left({}_1p_{G3}^{(T)} * l_{G3_{NEW}}\right)$$

$$= (0.95518 * l_{G1}) + \left(0.98361 * l_{G2_{NEW}}\right) + \left(0.98992 * l_{G3_{NEW}}\right).$$

Discussion

As mentioned before, the causes of withdrawal were not studied in this analysis because the majority of students chose Other as their cause of withdrawal. This raises two questions about the data the Registrar is collecting. First, is there some cause other than those listed that explains why most students withdrew from the University? It is difficult to think of a cause for withdrawing that could not be roughly explained by Attend Another College, Death, Financial, Health/Medical, Military, or Not Continuing Education. That leads to the second question: is the process the Registrar is using ineffective at collecting meaningful information? Unfortunately, the answer to this question is yes.

If the Enrollment Management Department wants to draw conclusions from the data they are collecting about the causes of withdrawal, they must change how they are conducting the exit survey. Currently, there are 37 options for why a student withdraws plus an area to explain if she feels one of those 37 do not adequately explain her situation. The 37 options are on the exit form in Appendix A. There are three issues with the current the exit form and how student responses are recorded. First, the broad categories of reasons do not match the reasons recorded in the system. The categories on the form are Academic, Wellness/Safety, Financial, Personal/Transition, Housing/Travel, and Family. The categories stored in the system are Attend Another College, Death, Financial, Health/Medical, Military, and Not Continuing Education. Therefore, whenever a form response does not fit into the system categories, the Registrar staff record the response as Other. If the Registrar would like to save accurate responses, they should at least use the same categories. Moreover, if they provide 37 responses, each should be recorded in the system as well. One might argue that this recording would be too time consuming, but once the system provides the option to record the detailed responses, it would take no longer than the current process. It may be even faster given the data recorder would not have to decide how to record a response when there is a mismatch between the form and database categories.

The second issue with the withdrawal form is that it allows students to select more than one reason for why they withdraw. While some students may have more than one reason for leaving the University, the form should either only allow one answer or ask the students to rate the importance of their reasons for withdrawal. For example, if a student selects “classes too large” and “difficulty making friends” as her reasons, she should be asked to clarify that 75% percent of her reasoning was class sizes and 25% percent was the socializing issue. Neither of these options is ideal, but they are necessary if the University hopes to use the information they collect to address the key issues that make students withdrawal to increase retention.

The third issue with the withdrawal process is that students are not required to submit a reason for withdrawing. If a student does not provide a reason, her answer is recorded as Other. Doing this gives the appearance that many students are unable to classify their reasons for leaving the University. Again, if the Registrar would like to make conclusions from the form, they should record responses as they truly are. The Registrar should add an option for No Response to the system so that users can accurately record student reasons. Furthermore, the Registrar should encourage all withdrawals to provide a reason. Because the Registrar is already interacting with those that are about to withdraw, they should be able to check if the students did not provide an answer and then ask them to do so before signing the document. None of the possible responses require too much detail, so all withdrawing students should be willing to provide an answer if they are asked. It is also likely that there are currently too many options on the form for students to actually select one. The Registrar may receive more responses if they were to reduce the options to just the six broad categories.

Another issue with collecting information about why students leave the University comes not from those that withdraw during the term, but those students that complete a semester and do not re-enroll the next semester. Accounting for the number of students that graduate, there was an average of about 675 undergraduate students that do not re-enroll each academic year (fall and spring semesters combined). Comparatively, there was an average of about 215 undergraduate withdrawals during the semester each academic year. The University reaches out to some students that do not re-enroll, but they are asking those students to re-enroll, rather than a reason for withdrawal. Collecting this data would significantly help a future researcher conduct an analysis on causes of withdrawals as it would more than triple the number of entries. However, this collection would also be very timely and expensive as these students do not have to communicate with the Registrar; they just do not sign up for classes.

Conclusion

This paper provides a method to assist the University of Northern Iowa Enrollment Management Department in developing enrollment policies designed to meet particular enrollment goals. It is, however, far from perfect. One limitation of this study is that it does not provide any information about the students that complete a semester but do not return the next semester. If these students were included, the number of withdrawals would more adequately address the withdrawal and admission issues faced by the University. Another limitation is that historical data may not properly reflect future results. This analysis should be periodically replicated to ensure that the results still match experience. A third limitation is that the researcher assumed students enroll in the fall, that it takes undergraduates students four years (eight semesters) to graduate, and that it takes graduate students three years (six semesters) to graduate. None of these three assumptions are true for all students. As such, the model will not adequately reflect those students that enroll in the spring, or undergraduates that do not graduate in eight semesters, or graduates that do not graduate in six semesters.

Future research could take a sample of students that have withdrawn each semester for the past few years. This sample of students could be used to do a focused interview study of the causes of withdrawal to allow for the improvement of the exit form. It is possible however that this method would not accurately record the reason the student held at the time of withdrawal. It is also possible that students would be unwilling to answer. Future research could also be conducted as a true multiple decrement analysis. The researcher could take a random sample of new freshmen and new graduate students follow them throughout their careers at the University carefully recording when and why students leave. Again, one must consider whether the efforts required to complete such an analysis are worth the limited conclusions that may be drawn from the results.

This study attempted to create a multiple decrement table enrollment at the University of Northern Iowa to identify the significant causes of withdrawal that might require greater attention, but because of minimal data, the researcher instead created a decrement table for total withdrawals. The decrement table allowed the researcher to calculate factors that the Enrollment Management Department can use if they wish to set a desired steady state of enrollment or number of graduates. It also identifies ways the Registrar could improve data collection that will aid in future identification of significant causes of withdrawal to increase retention.

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Appendix A: University of Northern Iowa Withdrawal Form

University of Northern Iowa Withdrawal Form

Student Name ______________________ Semester __________ University ID# ___________

Have you updated your address on MyUNIverse? YES NO Telephone (___) ___________

Advisor Name ______________________ Are you a **Student Athlete**? YES NO

Immediate/Future Plans:

____

Do you plan to return to UNI in the future? YES NO UNCERTAIN Are you an International Student? YES NO

Are you transferring to another Institution? YES _____________(please indicate school) NO UNCERTAIN
If Yes, when____________________

Do you feel UNI could have done more to meet your needs? (Please tell us how) Last date of Attendance____________

____

____

Upon your final decision have you visited with: Housing ____ Financial Aid _____ Business Office _____

Reason for withdrawal (check all that apply):

Academic Issues:

- Desired program was not available
- Quality of instruction did not meet expectations
- Needed courses not available
- Classes too large
- Inadequate academic support services
- Undecided major or vocation
- Lack of academic challenge
- Insufficient high school preparation

Wellness and Safety Issues:

- Unmotivated or tired of school
- Physical Health
- Emotional/mental health
- Addictions (alcohol, gaming, internet, etc.)
- Felt campus environment/community not safe
- Sexual harassment/abuse
- Bullying/verbal harassment
- Impact of natural disaster(s)

Financial Issues:

- Didn't have enough money to continue
- Change in family financial circumstances
- Incurred too much debt
- Scholarship/grant was not renewed
- Financial aid was not sufficient
- Transferred to a lower cost institution
- Increases in tuition and fees

Personal and Transition Issues:

- Felt out of place at the university
- Distracted by social life
- Difficulty making friends
- Inadequate study skills or lack of academic success
- Working too many hours
- Felt campus climate unwelcoming
- Military obligations

Housing and Travel Issues:

- Housing was unsatisfactory
- Issues with roommate or other students
- Commute too long
- Moved out of the area

Family Issues:

- Family illness/responsibility
- Homesick
- Wanted to be closer to family and friends

Other Reasons (use back if necessary)

____

Student Signature ______________________________ Date ___________

UNI Registrar Staff signature ______________________________ Date ___________

For Office Use Only

Semester __________ Reason_____________ Academic Fee Refund ________ SWD Hold __________

Date of Withdrawal ________ Record Card Entry ___________ Approval_________

Chapter 22 Code of Iowa: This information is requested to initiate your withdrawal from the University. Only directory information may be released to third parties. All items are required and therefore incomplete forms may not be processed.