STUDENT RETENTION AT ASHLAND UNIVERSITY: A STATISTICAL STUDY

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ABSTRACT

Ashland University has a retention problem similar to that of many other colleges and universities. This paper estimates a retention model for Ashland that uses not only the variables found in earlier works but also sociological factors that have not been used previously. It confirms the conventional wisdom for some variables but not for others. Students with higher secondary school grades are more likely to graduate from Ashland University, but ACT test scores have a very weak curvilinear relationship with retention. Variables such as economic status, parental education, and family structure have the expected positive results. In contrast, student work experience in high school has an unexpected but not statistically significant negative effect.

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I. INTRODUCTION

Student retention has become a major issue in higher education. Universities and colleges not only in the United States, but also in the rest of the world are concerned with this issue.[1] Several theories on why students leave college have been developed. Some scholars emphasize the sociological fit between the student and the college (Tinto, 1993). Others view the college experience as part of a search process by which young people attempt to define their career path. Sometimes, the search leads a student to stay at a given college and sometimes it does not (Manski, 1989).

Special insight into the problem can be obtained by examining the variables affecting retention at Ashland University (AU). Ashland is a middle-sized comprehensive university (roughly 2,100 undergraduates) that focuses on both traditional and non-traditional students with a wide diversity of academic abilities and sociological backgrounds. Retention is perceived as an issue at AU in that only about 50 percent of the new incoming freshman graduate (in five years or less).

Identifying the type of student who will graduate could do much to improve the performance of Ashland and other universities. Even if four-year retention is not necessarily the goal of the college or social policy, determining the characteristics of the students who graduate can help colleges to develop the appropriate admissions, course offering, and student life policies.

This paper develops a statistical model of retention at Ashland University (AU) that focuses on explanation rather than prediction. In addition to guiding student life policies, this analysis can be used to develop prediction models and to focus data collection efforts on the relevant variables.[2]

There are two reasons why this study may be of interest to people other than AU stakeholders. First, in addition to the commonly used variables, family characteristics such as parental vocation, the number of siblings, alumni connections, and geographic location are analyzed. Furthermore, individual attributes such as high school activities and job experience are included. Earlier analysts have developed theories suggesting these variables (Manski and Wise, 1982, and Willingham and Breland, 1982). Of special interest is a variable showing whether the two parents were living together at the time the student entered Ashland. A large literature suggests that individual success is related to the family structure (Clark, 1983 and Goldscheider and Waite, 1991).

The second reason for interest in this study is the information that it sheds on the ability of the two major college admissions tests, the College Boards (SAT) and the American College Test (ACT), to predict success. Many commentators denounce these tests, and studies of other colleges indicate that they are often poor predictors (Nairn and Associates, 1980). Other studies, however, have demonstrated the ability of the test to predict success in college courses (Watts and Lynch, 1989 and Watts and Bosshardt, 1991).

Ashland's student body has a wide range of ACT scores—from 12 to 33—making it a good sample from which to derive insights. Furthermore, AU uses the ACT test while most of the colleges studied earlier used the SAT test. Thus, an examination of the influence of the ACT test scores on retention rates could contribute to the understanding of this issue.

Consequently, this paper examines how student family and individual characteristics influence college retention. The next section develops the empirical model and explains the variables in the model. The third section describes the results, and a conclusion ends the paper.

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II. THE EMPIRICAL MODEL

In this paper, the probability of student retention at Ashland University is modeled. Retention, here, is defined as obtaining a degree from Ashland University. The student's retention decision can be seen as the result of the calculation of the net benefit of graduating from Ashland University compared to the next best alternative. Economists have modeled this decision process, and from this analysis a dichotomous dependent variable model can be derived (Greene, 2000 and Manski and Wise, 1982). Essentially, the net utility or gain from graduating is dependent on a set of variables, X, as follows:

$$Net\ Utility = g(X, \beta, u) \tag{1}$$

with β being a set of parameters and u, a residual indicating the variation in utility not accounted for by the model. When this net utility or gain is greater than zero, the student stays and graduates from Ashland, and when it is less than zero, he/she leaves. Thus, the dichotomous variable, RET, equaling one if the student graduates and zero otherwise, can be used as the dependent variable in a rendition of the following model:

$$Prob\ \ RET = 1\ \ = F(g, \beta, u) \tag{2}$$

Essentially, this equation states that the probability of a student graduating from Ashland University depends in some systemic fashion on variable vector, X. The probability part of this relationship can be approximated by a number of distributions. Different statistical techniques assume different distributions. The three most common techniques are Ordinary Least Squares regression (also called the Linear Probability Model or LP), Logit (using the assumption of a logistic probability for the residual, u), and Probit (using the assumption of a normal residual probability distribution).[3] Given data on the variables in X, the latter distributions are considered superior for a number of reasons.[4] This study follows the Manski and Wise work on student behavior by using the Probit model (1982, p. 40).

Before proceeding, this paper examines a potential estimation problem; selection bias. In order for a student to be in the sample, first, she/he must have originally been admitted to AU, and second, he/she must have decided to attend AU. Just as the decision to finish Ashland University arises from a net benefit calculation, so does the decision to attend Ashland University. Consequently, the students who decide to go to Ashland may not be a random sample of the universe of people thinking about college, and the results of a model using only the AU sample may not apply to non-AU students.

Under quite reasonable assumptions, however, this sequential decision process does not create estimation bias. People who do not apply to Ashland University believe that there are no net benefits from attending, let alone graduating from, Ashland. The characteristics that influence the likelihood of benefiting from an Ashland degree, then, are the same as those determining the desirability of applying to and attending the university. Consequently, the sample selection is mainly determined by the variables affecting retention.[5] If the independent variables for a model determining who is in the sample are not different from those in the model itself, the coefficients estimated by the model would be unbiased.[6] Thus, the paper proceeds on the assumption that coefficients in the estimation model are unbiased not only for observations within the sample but also those outside it.

Now that an empirical retention model has been posited, the next step is to examine the sample. The original sample consists of the 430 full-time students who matriculated as freshmen in the fall of 1996. On schedule, the bulk of the class would have graduated in 2000. Almost all of these students are

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traditional in that they were 18 or 19 years old when they started at Ashland. (Most all of Ashland University's roughly 400 non-traditional students are transfer students.)

Due to missing data on many of the independent variables, the sample used is first limited to 341 observations in the original class. The need to make out-of-sample led us to drop 50 students from the final estimation model. Since for any particular observation there is no systemic reason for any given variables to be missing, the analysis assumes the sample is random, meaning that inferences can be made about the population.

To understand the nature of the dependent variable, one must realize that many students change majors. Thus, a large portion of the traditional students take over four years to graduate. Accordingly, this paper's criterion for retention is whether the student graduated within five years of entering Ashland University.

The independent variables used in the model have been suggested by work on retention by McKnight (1997), Manski and Wise (1982), Willingham and Breland (1982). Table 1 and equation 3 show all of the independent variables that have been considered for use in the model:

$$RET = F[\, g(HSGPA, HSGPA^2, ACT, ACT^2, INTERACTION, NEED, SIBS, DIS, OHIO, OCC, PDEG, ALU, FAM, GENDER, BLACK, HSL, HSA, WEXP, HRS, HRS25, BUSC, EDC)]. \quad (3)$$

Table 2 displays the means and standard deviations for these variables for the sample used in the analysis. Economic and sociological theories support using all of these variables, but these same theories could also support omitting many of them from the model. Consequently, extensive specification tests are performed to find the model with the greatest explanatory power.

Once a reasonable starting vector of independent variables is determined, a top-down specification search procedure suggested by Maddala is used to find the most appropriate model (1992, p. 490–504). Experiments are done with the independent variables to see if they contribute to the explanatory power of the equation. If the coefficients are not significantly different from zero and if their t values are less than one, one can safely assume that they do not impact on retention at Ashland. In order to prevent omitted variable bias, however, the analysis does include variables that are theoretically required by the underlying economic model, even though the t values are less than one.

Here, each possible independent variable is examined to see how it might impact on retention. These variables can be classified into three categories: academic indicators, family characteristics, and non-academic individual attributes. Two academic variables available for AU students are considered important by most experts, the high school grade point average, HSGPA, and the American Test Company score, ACT. HSGPA reflects the actual academic performance of the student in secondary school, while ACT indicates the potential of a student to do college work.[7]

Some observers claim that very good students tend to get bored at Ashland and then transfer to other schools. This idea suggests that relationship between Ashland retention and academic ability is nonlinear. After a certain threshold, increasing academic ability may decrease the likelihood of Ashland University students graduating. To test this hypothesis, two quadratic variables, $HSGPA^2$ and ACT^2 are added to the model.

There may be students at Ashland University who perform much better in the classroom than their ACT scores would indicate—in other words, they are over-achievers. This phenomenon can be accounted for by including an interaction variable, the product of ACT and HSGPA. With this variable, called INTERACTION, one can model the possibility that the student's conscientiousness (as roughly measured

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by HSGPA) could change the impact of the ACT score on retention. If HSGPA increases the impact of ACT on retention, then, the INTERACTION coefficient is greater than zero.

The economic and social characteristics of student families can impact on retention at Ashland University. The financial variable most available and likely to impact retention is the difference between the expense of attending Ashland University and the amount a family can afford as determined by the Federal Student Aid Programs need formulas, called here, NEED. This variable indicates the family's capacity to finance the student's education.

More data are available on NEED than on straight income variables. Many families do not report their NEED or income data to the university. Thus, the income variable is unavailable for them, but since they did not see fit to apply for financial aid, one can infer that their NEED is zero.[8] Unlike income, one would expect the impact of NEED to be negative, greater need lowers the probability of the student graduating.

Another variable that might impact on the family's ability to send an offspring to college is the number of siblings, SIBS. This variable, too, would have a negative impact; a household with several children likely results in less money for any one child to finish college.

A third family characteristic that could affect student retention is geographic location. Willingham and Breland (1982) show that students are more likely to stay at colleges that are closer to their homes. For this influence, the variable, DIS, is used; one would expect it to have a negative impact.

Another aspect of family location is whether they live in the state of Ohio or not (OHIO). For many reasons, one can plausibly assert that students from Ohio are more likely to remain at Ashland University. Students from Ohio are more apt to know their fellow students from past experience. Examples of this experience might be family and parental connections and interscholastic activities, such as Boys' and Girls' State and athletics. Thus, Ohio students may feel more connected to Ashland University than out-of-state students.

It has been hypothesized that students from families with high social prestige are more disposed to finish college (Willingham and Breland, 1982, p. 164). Information available to this researcher on the parental jobs is exploited to set up a dichotomous variable, OCC, to depict whether one or more of the parents have a prestigious job.[9] One would expect this variable to have a positive impact. Since women from all types of families work as housewives, using a dummy variable for both parents with prestigious jobs may understate the proportion of students from families in such positions.

Experts agree that students whose parents have college degrees are more likely to finish college than others (Manski and Wise, 1982, chapters 4, 6 and 8 and Willingham and Breland, 1982, p. 164). To depict this situation, the dichotomous variable, PDEG, is included. Like OCC, it could be expected to have a positive impact.

Another family characteristic possibly impacting on Ashland University retention is whether one or more of the parents, siblings or close relatives are alumni. Thus, the dichotomous variable, ALU, is added to the model.

For two reasons, coming from a stable family may increase the likelihood of persistence for a student at Ashland University. A large literature posits that stable families will help people to pursue and fulfill their ambitions such as finishing college.[10] Second, anecdotal evidence indicates that people from conservative stable families are more likely to stay at Ashland University given its small town setting and religious orientation.

It is inferred that if both parents were living at the same location at the time of student's application, they were married.[11] Thus, a dummy variable, FAM, is created; it is expected to have a positive impact. Given this definition, 84.8 percent of the sample students were from families with both parents living together.

Non-academic characteristics of the individual students can influence retention. One of the most obvious non-academic characteristics of a college is gender. Therefore, the dichotomous variable (GENDER) is included in the model. Theory makes no prediction on the impact of this variable.

The undergraduates at Ashland University are homogenous ethnically. Caucasian Americans account for 92.1 percent of the 430 students in the 1996 class. Students from other countries constitute 2.3 percent of the class, and 2.6 percent of the sample are Black Americans. In this sample, there are no Native Americans, and very few American Hispanics and Asians. Other things equal, the retention rates for different ethnic groups could be quite different, and thus, it is prudent to include a variable reflecting this condition. Since many of the variables are not available for international students, most of them are not in the sample, and thus, no variable reflecting that condition is included. Therefore, only the dummy variable, BLACK, is included; theory does not predict whether this would have a positive or negative effect.[12]

Willingham and Breland (1982) hypothesize that outstanding accomplishments in high school extracurricular activities, athletics, and other non-scholastic endeavors lead to college success and retention. Thus, this paper examines two dichotomous variables: HSL indicating whether the student held a student organization office, and HSA indicating whether the student was a high school athlete. These variables should have a positive impact.

Work experience prior to college could also have a bearing on success in college. Information was collected on two aspects of student high school work experience. The first is whether the jobs held by the student were particularly challenging or responsible, and the second was whether the student had had a full-time job. For the first aspect, a dichotomous variable, WEXP, is included. It is expected to be positive.

For the second aspect of the high school work experience, data on the hours worked at student jobs were collected. Again the information was incomplete and often ambiguous, but enough was collected to consider using the variable. Thus, variables reflecting full-time job experience—for instance, maximum hours worked per week, HRS—are included in the analysis. Additionally, a dichotomous variable, HS25, indicating whether the student had a job with over 25 hours a week, is created. In the models, HRS25 yielded more plausible results, and so it was used.

Finally, two variables are used to indicate the AU College in which the students choose to enroll. Students enrolling in the AU College of Business and Economics and College of Education may have stronger or weaker desires to finish college at Ashland than those enrolling in the College of Arts and Sciences. Therefore, the dummy variables, BUSC, and EDC, are included in the model. Theory does not predict the impact of these variables.

III. THE RESULTS

The final estimates of the Probit model are reported in Table 3. This paper uses a nonlinear model with continuous variables entered as natural logs because this specification picks up relationships between retention and certain independent variables that the linear ones might miss. As stated above, variables not theoretically necessary are deleted from the model, if the t values are less than one. This should minimize omitted variable bias. It also allows the reader to examine variables with a possible impact but low statistical significance.

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Now, the results for the variables are described starting with the academic ones, and going onto the family characteristics and then finishing the individual attributes. Of the academic variables, high school GPA (HSPGA) is statistically significant. The square of high school grades, however, is not statistically significant. This insignificance indicates that the relationship of the dependent variable to the natural log of HSGPA if not the actual variable itself is linear. The logged specification may very well capture any nonlinearity that exists in the relationship in the model or the sample.

Experiments on different configurations of the ACT variable indicate that the impact of this variable is nonlinear. Using the natural log model allows for a nonlinear impact, but it does not allow the sign of the impact to change; the coefficient for ln ACT has to be either positive or negative. When the ln quadratic variable $(\ln ACT)^2$ is added, however, the sign of the impact for ACT changes over different parts of the sample. For the AU sample (Class of 2000), the effect of ACT is positive at its lower levels, and this impact changes to negative in the middle of the sample at 22. However, these two variables are not statistically significant at the 5 percent level, meaning that one cannot have a great deal of confidence in the ACT results. Furthermore, at no ACT value is the level of the total impact significantly different from zero using a level of significance of 5 percent.

While the discussion in section II suggests that the interaction between HSGPA and ACT is appealing as a variable, the statistical results indicate that it is not important in the Ashland University environment. Since its t value is less than one, INTERACTION is not included in the final model.

The next variable, NEED, is included in the model even though it has a low t value, because it is theoretically necessary. With college expenses a large part of most family incomes, it is inconceivable that finances do not play a role in the decision to finish college. Statistically, however, the NEED variable is insignificant with a very small but predicted regression coefficient.

To illuminate this question, the predicted impact of NEED on the likelihood of finishing in five years is examined. With the Probit model, this impact does not equal the regression coefficient; rather it is a multiplicative combination of the coefficient and the normal likelihood function; it can vary with the value of the variables. At the mean of the sample, the Probit model impact of the NEED variable on the probability of graduation is only -0.0000005, thereby lowering a student's need by $10,000 would only increase the probability of graduating by 0.006 percentage points. This small effect seems counterintuitive. Through scholarships and loans, however, a university may be able to insure that students have the resources to finish, and thus, a large influence for NEED might not be expected.

Theoretical and empirical analysis indicates that the following family variables, ln DIS, OHIO, OCC, PDEG, ALU and FAM, may impact retention. For ln DIS, the natural log of the distance of the student=s home from Ashland, the results contradict earlier studies showing that greater distance from a college lowers a student=s likelihood of graduating. At Ashland, the coefficient for ln DIS is positive but not significant at the 5 percent level. This implies (albeit weakly) that living farther away from Ashland increases the likelihood of a student graduating, but one cannot place a great deal of confidence in the result.

The remaining family variables are dichotomous. OHIO, reflecting geography, is positive and statistically significant indicating that coming from Ohio increases the likelihood of a student graduating from Ashland University. The results are consistent with earlier studies showing that a geographic connection with a college has a positive influence on retention. It may very well be that coming from Ohio gives students a connection with other students that creates a greater desire to stay and graduate. The results for OCC, whether one or both of the student's parents held a prestigious job, is suggestive but inconclusive, being statistically significant at only the 10 percent level. Thus, coming from a family with one member

holding a prestigious job may increase the likelihood of graduation, but not much confidence can be placed in the result. The coefficient for PDEG is positive as predicted and significantly different from zero at the 5 percent level for a one-tail test. This indicates that students at Ashland tend to graduate more often if their parents have finished college. The coefficient for ALU, the dummy variable indicating whether the student has any alumni relative, is positive as predicted and statistically significant at the 10 percent level of significance. The results for the FAM dummy suggest that students from stable families tend to have a higher probability of graduation compared to those who do not. The coefficient is positive as predicted and statistically significant at the 5 percent level of significance. The other family characteristic variable, SIBS, was not statistically significant and excluded from the model.[13] Apparently the number of the student's siblings has little influence on retention.

Three of the individual characteristics have a substantial impact on AU retention, HR25, a dummy for working over 25 hours at jobs in high school and the two dummies for the AU colleges. HR25 has an unexpected coefficient, negative instead of positive. Since the sign is unexpected, a two-tail test is used to see the coefficient is significantly different from zero. It is statistically significant at the 10 percent level on this test. The expectation is that having worked longer hours at a job during high school would, by making students more responsible, lead to greater likelihood of finishing college. Nonetheless, as the number of work hours on jobs in high school increases, the probability of a student graduating from Ashland is lowered.

One possible explanation for this result is that people who work more in high school do not have the financial resources to finish Ashland. When interaction terms between NEED and hours were added to the model, however, the coefficients are not significantly different from zero. Thus, the negative effect of HR25 does not appear to be connected to financial need.

Another theory consistent with this result would be that greater job experience gives students a better ability to operate in the labor market, and therefore, to obtain better jobs without a college degree. This would increase the perceived opportunity cost of going to college because these students would be giving up a greater income compared to less experienced people. Notwithstanding, this theory obviously needs further testing. For all these interesting speculations, one cannot rely on these findings to draw conclusions without testing the theory with other samples.

Apparently, the students who enroll in either the AU College of Business and Economics or the AU College of Education have higher graduation rates compared to the students starting in the AU College of Arts and Sciences. The coefficients for the Business and Education school dummies, BUSC and EDC, are positive indicating that students in these schools are more likely to graduate than students in the Arts and Sciences.

The following variables depicting individual characteristics were not only statistically insignificant but also have t values below one: GENDER, BLACK, HSL, HSA, and WEXP. Since they are not theoretically necessary, they were not included in the final model. GENDER being insignificant implies that the retention rate, other things equal, does not materially differ between the genders. The results also suggest that other-things-equal, the African-American students have similar graduation rates compared to all other AU students. The insignificant results for HSL and HSA indicate that being a high school leader or athlete does not increase a student's probability of graduating from Ashland University. The last result contradicts earlier findings indicating that extracurricular activities prepare a student for college.

Additionally, the coefficient for the variable for the job quality, WEXP, was not statistically significant and also excluded from the final model. Apparently, people who have had responsible jobs during their high school years are no more prone to graduate from AU than other students.

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The overall results of the model indicated that from a probabilistic viewpoint, the model is successful. The Log-likelihood ratio for the probit model is 80.870, which is statistically significant at the 1 percent level. Thus, the probability that the results occurred by chance is extremely low.

A second indicator of the success of the model is its ability to predict whether individual students would graduate. The contingency charts at the bottom of Table 3 show this ability for the in-sample observations and fifty out-of-sample observations. Of the 430 students in the class of 2000, the data necessary for the model are available for only 341. As stated above, fifty observations are excluded from the estimation sample in order to scrutinize the out-of-sample ability of the model to predict. The contingency charts at the bottom of Table 3 show that the model predicted 147 (50.5 percent) of the 291 observation students would graduate as compared to the 144 or 49.5 percent who actually did graduate. More important is the overall accuracy of the model predictions. Within the sample, the model correctly predicts whether or not 208 students graduated, a success rate of 71.5 percent.

The difficulty with this result is that it is within the sample; it may not be relevant to observations outside the sample. Thus, it is important to examine the prediction rates for the students not in the sample. For the 50 observations outside the estimation sample, the model correctly predicts that 15 would graduate and that another 15 would not graduate, for an overall accuracy rate of 60 percent. By merely assuming every student would graduate, however, one would arrive at an accuracy rate of 46 percent because for the fifty students the retention rate is 46 percent. Thus, the improvement wrought by the model is substantial. The purpose of this model, however, is more for explanation than for prediction, but this improvement implies that the variables used here influence retention.

IV. CONCLUSION

The results of this study indicate that students with higher HSGPAs are more likely to graduate from Ashland University. At the lower end of the score distribution, moreover, raising the minimum ACT could increase the graduation rate. Thus, conventional wisdom is supported implying that a mixed strategy raising both HSGPA and ACTs in selecting student applicants may be an efficient way to raise retention.

Of special interest to other colleges is the curvilinear relationship between retention and ACT. It is positive at low levels of the variable, but negative at high levels. There may be an ACT level for which Ashland best fits the student's needs and goals. Students very far below or above this range tend to leave. Possibly this phenomenon exists at other colleges. There may be ACT or test score niches for which given colleges are optimal. This is consistent with the sociological fit theory of Tinto (1995). This clustering of scores may also explain the lack of statistical significance for the relationship between these test scores and retention.

For some of the sociological variables, the study confirms the works of other scholars. Instate students are more likely to graduate from Ashland than others. This result is also consistent with Tinto in that Ohio students may very well fit into Ashland better than out-of-state people.

Students from families with prestigious jobs, college degrees, and alumni connections are also more likely to graduate from AU. For these characteristics, the conventional policy recommendations are appropriate.

For other variables, the results for Ashland are so different from other studies that special attention is warranted. Students who had worked over 25 hours during high school tend not to stay at AU. Another set of students who do not stay at Ashland are those from one-parent families. It is important to examine these issues further.

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The final important result from this study is the difference between the retention rates for the AU colleges. The retention rate for the College of Arts and Sciences is below those of the other two colleges. This is consistent with both the fit model of Tinto and the search model of Manski (1989) in that the students in these colleges may have a clearer picture of their goals than the Arts and Sciences students. It would seem incumbent on the AU administration to study the problem in much more detail.

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Table 1.
The Variables in the Ashland University Retention Model

Variable	Definition
RET	Equals 1, if the student graduated from Ashland University within five years or less from first entering, and 0, otherwise.
HSGPA	The student's high school grade point average.
$HSGPA^2$	HSGPA squared.
ACT	American College Test score which measures the aptitude of a student for college work.
ACT^2	ACT squared.
INTERACTION	ACT*HSGPA.
NEED	The difference between the expense of attending AU and the amount a family can afford as estimated by the Federal Student Aid Programs need formulas measured in dollars.
SIBS	The number of siblings.
DIS	The distance between the student's home and Ashland University measured in miles.
OHIO	Equals 1, if the student's home is in Ohio and 0, otherwise.
OCC	Equals 1, if one or another or both parents have prestigious jobs and 0, otherwise.
PDEG	Equals 1 for students one or more of whose parents are graduates of a four year college and 0, otherwise.
ALU	Equals 1, if the student is closely related to an alumnus and 0, otherwise.
FAM	Equals 1 if the parent were together and 0, otherwise.
GENDER	Equals 1 if student is male.
BLACK	Equals 1 if the student is black.
HSL	Equals 1 for students who held a student organization office during high school and 0, otherwise.
HSA	Equals 1 for students who were athletes in high school and 0 otherwise.
WEXP	Equals 1 for students who in this writer's judgment held particularly responsible, interesting and difficult jobs and 0, otherwise.
HRS	The maximum hours worked per week in the high school years.
HRS25	Equals 1 for students who worked over 25 hours a week in the high school years and 0, otherwise.
BUSC	Equals 1 for students who enter the College of Business and Economics and 0, otherwise.
EDC	Equals 1 for students who enter the College of Education and 0, otherwise.
Data collected by the author.	

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Table 2.
Variables in the Ashland University Retention Model

Variable	Mean	Std. Deviation
RET	0.51	0.501
HSGPA	3.089	0.565
ACT	21.906	3.679
NEED	11950.72	7055.02
SIBS	1.765	1.214
DIS	106.15	150.127
OHIO	0.88	0.326
OCC	0.757	0.43
PDEG	0.475	0.5
ALU	0.188	0.391
FAM	0.848	0.36
GENDER	0.543	0.499
BLACK	0.026	0.161
HSL	0.531	0.5
HSA	0.692	0.462
WEXP	0.106	0.308
HRS	24.516	12.219
HRS25	0.405	0.492
BUSC	0.202	0.402
EDC	0.182	0.386

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TABLE 3.
The Results for the Logarithmic Specification of the Ashland University Retention Model

Variable	Coefficients	z or t value	p-value two tail	p-value one tail
Intercept	-33.886			
Ln HSGPA	2.553	4.31	0.000	0.000
Ln ACT	19.127	1.33	0.183	0.092
$(\text{Ln ACT})^2$	-3.121	-1.33	0.183	0.092
Ln NEED	-0.019	-0.79	0.432	0.216
Ln DIS	0.103	1.28	0.200	0.100
OHIO	0.687	2.32	0.021	0.011
OCC	0.319	1.40	0.161	0.081
PDEG	0.327	1.70	0.089	0.045
ALU	0.312	1.34	0.180	0.090
FAM	0.430	1.77	0.076	0.038
HR25	-0.295	-1.70	0.089	0.045
BUSC	0.336	1.53	0.125	0.063
EDC	0.713	3.46	0.001	0.000
Log-Likelihood Ratio	80.870		Not relevant	0.000

The estimation program used is Limdep developed by William H. Greene, Econometrics Software, Inc. Plainview, New York.

Here, both the two and one tail probability values are displayed because some hypotheses involve a two tail and some involve a one tail test.

Frequencies of actual & predicted outcomes predicted by the Probit Model.

Actual versus Predicted Probability of Graduation:

Within the Sample Predictions				Out of Sample Predictions			
	Predicted				Predicted		
Actual	Grad.	No Grad.	Total	Actual	Grad.	No Grad.	Total
Graduated	104(0.357)	40(0.137)	144	Graduated	15(0.300)	| 8(0.160)	23
Not Graduated	43(0.148)	104(0.357)	147	No Graduated	12(0.240)	15(0.300)	27
Total	147	144	291	Total	27	23	50

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ENDNOTES

[1]See Brunello and Winter-Ebmer, 2003, Montmarquette, Mahseredjian, and Houle, 2001, Kerkvliet and Nowell, 2005, and Van Ours and Ridder, 2003.
[2]For the distinction between models for explanation and prediction, see Greene, 2000, p. 842–844.
[3]See Pindyck and Rubinfeld, 1998, p. 298–318, Maddala,1992, p. 322–338, and Greene, 2000 p. 811–895 for good discussions of these estimation techniques.
[4]The results for all three methods have been examined, but little difference between them is found. This is consistent with the literature which concludes that very little difference can be expected (Greene, 2000, p. 815).
[5]See Manski and Wise, 1982, for models of the application, attendance and retention decisions by college students; they use most of the same variables in all three models.
[6]See Wooldridge, 2000, p. 299–300 and p. 558–560.
[7]With these statistics, there are two problems. First, different secondary schools have different standards, and no really adequate way exists to model the secondary school differences in the Ashland University sample. In other samples, perhaps, ways to account for this problem can be developed. Second, some students, 35 in all, took the College SAT Board test; these scores are converted to ACT equivalents using the American Testing Company algorithms.
[8]For models with income included, Manski and Wise (1982) use a dummy variable valued at one when the INCOME is not available and zero, otherwise. Models for this sample with the income and dummy variables have been analyzed, but the models with NEED still seem more plausible, if for no other reason than the greater availability of credible data.
[9]In addition to the usual professional people and executives, this paper defines as prestigious, such jobs as teacher, nurse, sales person in a large company, manager, and business owner.
[10]See Clark, 1983 and Goldscheider and Waite, 1991.
[11]Whether the parents were living together at the time the student applied to Ashland University is the best indicator available on the status of the student's home life. Admittedly it is not perfect.
[12]It should be noted that using ethnic or gender criterion may be illegal for admissions decisions, but including them in an explanatory model is useful because it may point to potential retention problems with particular ethnic groups.
[13]Any coefficient with a t-value less than 1 is excluded from the final model.