Order Number 9222630

Determinants of student course withdrawals

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Middle Tennessee State University, 1992

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DETERMINANTS OF STUDENT COURSE WITHDRAWALS

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A dissertation submitted to the
Graduate Faculty of Middle Tennessee State University
in partial fulfillment of the requirements
for the degree Doctor of Arts

May, 1992

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ABSTRACT

DETERMINANTS OF STUDENT COURSE WITHDRAWALS

by Samuel Dossugi

This study investigates the determinants of a student's decision to withdraw from specific courses in higher education. The study was conducted at Middle Tennessee State University, Murfreesboro, Tennessee, using data from the Fall and Spring semester of the 1990-1991 academic year of four principles courses from four departments.

A simple model of course withdrawal is introduced. It consists of three groups of explanatory variables: student attributes, pre-semester background, and class attribute variables. Interactions among these variables determine the level of satisfaction the student obtains from the course which, in turn, determines the decision to withdraw. The model is tested using the logit technique. For the purpose of comparison, however, ordinary least squares (OLS) and probit results are also presented. The predictive power of the model is measured by count-R^2, and to determine whether the model is replicable, pseudo-R^2 is used.

Overall, the models fit well for both the Fall 1990 and the Spring 1991 cohorts. But individually, only several variables show significant relationships with course withdrawal.

The results of the study indicate that the older the student, the less likely he or she is to withdraw from the currently taken course. This finding, however, contradicts to a previous study by Adams and Becker. It is also found that students who attempt less credits are more likely to withdraw from any given course, which is contrary to what is expected.

The number of hours completed prior to the semester tends to be positively correlated with withdrawals. Thus, students with more experience in the sense of having completed more credit hours are more likely to withdraw. In addition, it is also found that students who have tended to persist in the past are less likely to withdraw. Finally, this study reveals that students who like to withdraw from courses tend to have lower grade point averages.

ACKNOWLEDGMENTS

I am privileged to have had Dr. Joachim Zietz, Dr. John B. James, and Dr. Bob Womack as my committee members for this dissertation. All have been very helpful in providing me with guidance, suggestions, and encouragement. As my committee chairman, Dr. Zietz has always been behind me in this process, especially in helping me to develop my ideas until it could be presented as a workable dissertation topic as well as continuously monitoring and providing advice during the research. My discussions with Dr. James have provided useful ideas and inspiration. And through Dr. Womack's lectures, I learned many things that have turned out to be very helpful when this research was carried out.

Contributions of knowledge and experience by the graduate faculty and friends during the course of my graduate study and in the development of this dissertation are gratefully acknowledged. Deep appreciation is also extended to Dr. Kiyoshi Kawahito, Dr. Billy W. Balch, and Dr. John Lee for their encouragement.

Special thanks are due to my parents and family who continuously provided support. I particularly want to thank my beloved wife, Yenny, and our two special boys, Ivan and Steven for enduring years of getting less than their fair share of attention from me.

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CHAPTER I

INTRODUCTION

Every semester registrars' offices at most colleges and universities across the United States are burdened with students who engage in dropping and adding courses. Though this process is described as having nightmarelike attributes (Mueller et al., 1981), it is also realized that adding and dropping courses are part of the registration process that requires some attention and adequate handling. As expressed by Adams and Becker (1990, 520), " . . . this is the time during which students gain information for an informed decision to stay or abandon the course."

Although course withdrawal can be a positive act for some students, it can also be a process resulting in loss of time and effort. More specifically, course withdrawals can significantly affect a student's plan to graduate on time. To discourage students from dropping and adding courses, some colleges and universities have attempted to limit the drop-add period. Others seem to follow the opposite view, that is, to impose minimal restrictions and develop a system that is able to handle all drops and adds efficiently (Watson 1974).

At Middle Tennessee State University, a student who drops a course after the free drop-add period and up to the

eighth week of the semester will receive a permanent grade of "W" on his or her transcript.

The drop-add problem has been investigated by many authors, such as Watson (1974), Mueller et al. (1981), Wollman and Lawrenz (1984), Fleming, Hill, and Merlin (1985), Morris (1986), Ward and Gowan (1989), and Adams and Becker (1990). It is only the work of Adams and Becker (1990), however, that provides a model of the determinants of the course withdrawal decision. Specifically, their research has focused on characteristics of the student and of the institution that were correlated with the withdrawal decision.

Purpose of Study

Withdrawals from specific courses raises a critical question: What accounts for these withdrawals? The purpose of this study is to address this question. Specifically, this study is designed to find an answer to the following question: What variables are associated with course withdrawal and how do these variables operate and interact in the withdrawal process? If factors affecting course withdrawal are properly identified, policies that aim to decrease the withdrawal rate could be developed.

While studies on student withdrawal from colleges and universities have been written extensively since the work of Spady (1970) and Tinto (1975), there have been few studies on student withdrawal from specific courses. The seminal

work in this area is Wollman and Lawrenz (1984) on the determinants of withdrawals from physics classes. Several later studies have also been reported (Fleming, Hill, and Merlin 1985; Ward and Gowan 1989). However, it was not until the work of Adams and Becker (1990) that a comprehensive study on course withdrawal was conducted. Adams and Becker (1990) develop a probit model in an attempt to find factors that influence students to withdraw from specific courses. They hypothesize that course withdrawal is a good measure of teaching failure in a course.

This study is inspired by the work of Adams and Becker (1990), but it differs from it and similar studies in two respects: (1) econometric methodology and (2) methodological innovation. More specifically, instead of using the probit approach as did Adams and Becker (1990), this study uses a logit analysis in detecting the determinants of course withdrawals. For a comparison, however, the probit model is also applied. In addition, this study also analyses the effect of course withdrawals on the student's success as indicated by current grade point average (GPA).

Information about why students withdraw from specific courses, and how student and class characteristics interact in the withdrawal process could be a useful input for decision making by university administrators. This information may lead to an improvement in student advising

especially in assisting students to select a course as well as in class scheduling. In addition, this information could also be used to reformulate course withdrawal regulations which aim to reduce the number of course withdrawals.

Assumptions and Limitations

Several assumptions are made as a part of this study. First, it is assumed that course withdrawal is the subset of college withdrawal in that factors influencing a student to withdraw from a course can be derived from factors affecting college withdrawal. Second, it is assumed that satisfaction is an appropriate measure of student course withdrawals.

This study is limited in several respects. First, the results apply to a large public and urban university. Consequently, inferences drawn from this study may or may not be representative for the United States as a whole. Second, the analysis is based only on four principles courses which might not be enough to represent the whole population. Third, the sample on which the results are based represents students who enroll at Middle Tennessee State University in the Fall and Spring semesters of academic year 1990-1991. Thus it is not a longitudinal study in which better results are usually found.

Organization of Study

The study is divided into five chapters. Chapter II reviews the relevant and related literature pertaining to

course withdrawals. The one that is closely related to the course withdrawal issue is college withdrawal or attrition. Hence attrition is discussed at length to provide an adequate background for the study of course withdrawal.

In Chapter III, a simple model for course withdrawal is developed. In building the model, it is shown that satisfaction, which is derived from utility maximization, is of crucial importance. Methodology and limitations of the tests are presented. The two statistical methods discussed are the probit and the logit-regression analyses.

Chapter IV presents empirical results from the model. Descriptive results of the study are presented first. Then a comparison is made between the ordinary least squares (OLS) and the probit-logit approaches as well as between the probit and the logit. In addition, the effect of course withdrawals on the student's success is also presented.

Chapter V summarizes the study and discusses the study's implications. Recommendations for future research are also provided.

CHAPTER II

REVIEW OF RELATED LITERATURE

Student withdrawal is studied at both the level of the college or university and the course level. Reasons provided for withdrawal at the college level differ widely among studies and institutions. Explaining the variation in student withdrawal, in fact, has long been a major concern of the experts associated with the field (Astin 1975; Cervantes 1965; Cope and Hannah 1975; Kesselman 1976; Licther et al. 1962; Panos and Astin 1968; Pantages and Creedon 1978; Pascarella 1980; Sexton 1965; Spady 1970; Summerskill 1962; Tannenbaum 1966; Tinto 1975). This concern arises primarily from a desire to improve theories that explain student withdrawal behavior because student withdrawal is usually costly to both the student and the institution.

Much research has been conducted on student withdrawal from colleges and universities, yet a general profile of withdrawal has not emerged (Aitken 1982; Baumgart and Johnstone 1977; Bean 1980, 1982b, 1985; Braxton et al. 1988; Fetters 1977; Mallette and Cabrera 1991; Metzner and Bean 1987; Munro 1981, Pascarella and Chapman 1983; Pascarella, Duby, and Iverson 1983; Pascarella and Terenzini 1980; Spady 1971; Stage 1988; Terenzini, Lorang, and Pascarella 1981).

Tinto (1982a, 14) suggests, this is because " . . . it involves not only a variety of perspectives but also a range of different types of dropout behavior." A theory that could capture every facet of the withdrawal process would contain so many constructs that it would become unmanageable. In contrast to the numerous studies at the college level, little work has been devoted to student withdrawals at the course level. Recent exceptions include the studies by Wollman and Lawrenz (1984), Fleming, Hill, and Merlin (1985), Ward and Gowan (1989), and Adams and Becker (1990).

Student withdrawal at the course level can be considered as a subset of withdrawal at the college level, since, theoretically, the latter is nothing but all course withdrawals. Accordingly, there are most likely some factors that play a role in both withdrawal from the college or university and course withdrawal. The purpose of this chapter is to provide an understanding of the theoretical and empirical background of the more specific issue of course withdrawal by reviewing the most important studies on the broader issue of student withdrawal from the college or university.

Student Withdrawal

Concern over the student withdrawal problem has been expressed for more than 40 years (Munro 1981). Yet, dropout problems are so complex that no single characteristic,

socioeconomic condition, or cultural feature can be used as an indicator to detect potential dropout students (Titone 1982). Comments on the complexity and profusion of withdrawal studies have been expressed at length by Spady (1970), Tinto (1975), Pantages and Creedon (1978), Bean (1980), and Pascarella (1980), to name but a few. These authors point out that, although a lot of studies have been published on total withdrawal, much remains unknown about the nature of the withdrawal process. One reason is that there is still no consensus among experts about what factors constitute an appropriate definition of withdrawal (Tinto 1982a).

Various definitions exist of "attrition rate". Attrition can be defined as the percentage of students lost to a particular division within a college, to the college as a whole, or to higher education as a whole. The various definitions have been examined by Summerskill (1962). Although most of the earlier studies define a dropout as a loss to the particular college, Eckland (1964) and Selby (1973) are more concerned with withdrawals from higher education as a whole. Panos and Astin (1968) however, do not follow the usual definition, rather they define a dropout as any student who fails to attend college for four years.

Another concern that needs to be addressed here is the rate of attrition. The early work by Iffert, published in

1957, concluded that 50 percent of the entering class will be "lost" at an average college by the end of four years. This finding was confirmed by Summerskill (1962) after reviewing 35 attrition studies conducted over a forty-year period since 1913. In their summary, Gilbert and Gomme (1986) report the same magnitude. A shortcoming of these findings is that no distinction is made between permanent and temporary withdrawal from higher education. By taking into account this problem, Eckland (1964a, 1964b) found that the rate of withdrawal was around 30 %. In addition, Fetters (1977) found that the withdrawal rate for freshmen was 17 %, and for sophomores 11 %. Since most withdrawals happen during the freshman and sophomore years, Eckland and Fetters' findings could be considered similar.

Astin (1975) found that the most frequent reasons for withdrawal are boredom with courses, financial problems, dissatisfaction with requirements or regulations, and change in career goals. Poor grades are less important for females than for males, but marriage, pregnancy, or other family responsibilities are more important for females than for males. A national longitudinal study by Fetters (1977) revealed that students with academic problems withdrew for reasons such as job offers and financial problems. Students with nonacademic problems withdrew for reasons such as financial problems, marriage plans, uncertainty about plans, and a desire to have practical experience.

Factors Associated with Withdrawal

A variety of factors has been associated with student withdrawal over the years (Bayer 1968; Newlon and Gaither 1980; Pantages and Creedon 1978; Sexton 1965; Summerskill 1962). They can be grouped into seven major categories: demographic, academic, motivational, personality, institutional environment, and financial factors.

Demographic Factors

Although demographic factors are not so effective in explaining the process of attrition in general, they are of importance for certain groups of students with increasing percentages of dropouts (Lenning 1982). Demographis factors include age, gender, socioeconomic status, ethnic background, hometown location and size, and size and type of high school.

Age

Several studies suggested that older students are more likely to drop out than younger students (Sexton 1965; Summerskill and Darling 1955). Various interpretations have been put forth to explain these results. According to Summerskill (1962), factors that have delayed older students in attending college may very well continue and contribute to withdrawal. Lenning (1982), on the other hand, pointed out that although older students tend to be inferior in academic skills, they are more highly motivated as well as

more mature. Accordingly, different results would not be unexpected from other studies in this area (Bragg 1956; Eckland 1964a; Suddarth 1957; Thompson 1953). Eckland, in fact, found that students who have completed military service prior to college are less likely to withdraw. Thus it seems, as suggested by Pantages and Creedon (1978, 57), that " . . . age is not a primary factor in causing attrition." However, Lenning (1982) agreed that age may be associated with other reasons that determine dropping out. As pointed out by Grosset (1991), academic and social integration is the most crucial factor to the persistence of younger student.

Gender

A single-institution study by Newlon and Gaither (1980) reveals that the attrition rate of males is lower than that of females. This result confirms previous studies by Astin (1964) and Tinto (1975). However, other studies have found that male dropout is higher than female dropout (Demos 1968; Nelson 1966). These results contradict earlier studies that found no significant difference in the overall withdrawal rates between males and females (Bragg 1956; Iffert 1957; Johansson and Rossman 1973; Sewell and Shah 1967; Slocum 1956; Suddarth 1957; Summerskill and Darling 1955). In studying the determinants of attrition, Bean and Creswell (1980) find that family responsibilities make females more

likely to drop out, while college's perceived practical value makes them more likely to persist.

Socioeconomic Status

Lenning's (1982) summary concluded that there is a relationship between socioeconomic status and the dropout rate. Students from higher socioeconomic levels tend to have lower attrition rates than less advantaged students. Parental education is found to be the dominant factor in this relationship. The same result is also reported in other studies (Eckland 1964a; Panos and Astin 1968; Slocum 1956; Zaccaria and Creaser 1971). Summerskill (1962), on the other hand, stated that the hypothesis of socioeconomic status as a factor in attrition is empirically equivocal. Also, in their review, Pantages and Creedon (1978) conclude that the effects of socioeconomic status factors on rates of attrition are of limited value. Eckland (1964a) suggested that more than a ten-year period is needed to assess the significance of socioeconomic status factors in predicting attrition.

Ethnic Background

Earlier studies have found that dropout rates for Blacks or Hispanic are higher than for Whites (Flax 1971; Astin 1975). The same result is obtained by later reports (Allen 1987; Attinasi 1989; Lenning 1982). Contrary to this finding, however, Fetters (1977), and Pedrini and Pedrini

(1978) found no significant ethnic differences in dropout rates.

Hometown Location and Size

Some studies find that students from rural or out-of-state areas drop out more often (Lenning 1982; Stork and Berger 1978; Summerskill 1962). Specifically, Stork and Berger point out that the distance zone from college or university is approximately 210 miles for persisters and 360 miles for dropouts. Other studies, however, are unable to confirm these findings (Fishman and Pasanella 1960; Iffert 1957; Johansson and Rossmann 1973).

Size and Type of High School

Previous studies find a significant relationship between the size of high schools and attrition rates in college (Suddarth 1957; Thompson 1953). These findings are very well supported by the work of Little (1959) and Anderson (1974). But, as noted by Little, other factors such as high school rank, intelligence test scores, and high school achievement also play an important role in his finding. However, a later review by Pantages and Creedon (1978) shows that most of the research results fail to support previous findings.

Like the size of high school, the relationship between the type of high school and dropout has been inconclusive.

Astin (1973) and Freedman (1956) found that students from private rather than public high schools have lower attrition rates. Pantages and Creedon (1978) tended to support this finding if the relationship between the type of high school and attrition is significant. Sexton (1965), however, concluded that graduates of public high school have better chances of persisting in college.

Academic Factors

Academic factors have been found to be the most reliable predictor of withdrawal (Demitroff 1974). These factors are also important for evaluating the type of withdrawal; that is, whether it is academic dismissal or voluntary withdrawal (Vaughan 1968). Academic factors to be discussed include high school GPA and class ranking, scholastic aptitude, college grades, and study habits.

High School GPA and Class Ranking

Many studies have suggested that high school GPA and class ranking can be used to differentiate between potential dropouts and persisters (Blanchfield 1971; Bragg 1956; Little 1959; Morrisey 1971; Panos and Astin 1968; Scannel 1960; Slocum 1956; Stork and Berger 1978; Summerskill 1962; Waller 1964). However, the relationship between high school GPA and class ranking, on the one hand, and dropout, on the other hand, are usually not significant (Blanchfield 1971; Rossmann and Kirk 1970; Scannell 1960). As measured by the

correlation coefficient, this relationship is around 0.50 (Fishman and Pasanella 1960; Marsh 1966; Waller 1964). But in view of this, Pantages and Creedon (1978) asserted that though academic factors are not the main contributor for dropout (Marsh 1966), low correlations of 0.50 should not be ignored altogether. A recent study by Nelson, Scott, and Bryan (1984) found that high school GPA is significant in predicting dropout if the analysis is based only on precollege variables.

Scholastic Aptitude

Several studies and reviews suggested that, on measures of scholastic aptitude, there is a significant difference between dropouts and persisters (Lenning 1982; Nelson, Scott, and Bryan 1984; Sewell and Shah 1967; Slocum 1956; Summerskill 1962). However, Pantages and Creedon (1978) observed that although scholastic aptitude measures are the most significant predictors of dropout, they account for only a small proportion of the variance.

College Grades

Summerskill (1962) reported that at least 35 studies on the relationship between college grades and dropout show a significant association. This result is confirmed by other studies (Conner 1968; Daubman et al., 1985; DeBoer 1985; Morrisey 1971). It seems that these studies support the hypothesis that poor grades during the first semester are

highly predictive of dropout rates. However, Lenning (1982) found that although dropouts indicate to have somewhat lower grades than persisters, most of them have satisfactory grades. Pantages and Creedon (1978), on the other hand, cautioned that poor grades should not be assumed as the cause for dropping out.

Study Habits

Students with poor study habits are more likely to withdraw because of poor scholastic performance (Astin 1975; Lenning 1982; Pantages and Creedon 1978). Demitroff (1974) found that students who withdraw more frequently reveal poorer study habits than persisters. Other reports show that successful students do more studying and work than the average student (Sexton 1965, Trent and Ruyle 1965).

Motivational Factors

A majority of studies have found that motivational factors are the most important variables in the process of dropping out (Iffert 1957; Lenning 1982; Summerskill 1962). However, as pointed out by Pantages and Creedon (1978), determinants of motivational factors are usually very difficult to measure. These factors include motivational level and commitment, reasons for attending college, vocational and occupational goals, educational interests, and parental aspirations.

Motivational Level and Commitment

It has been observed that those students who expect to withdraw are more likely to withdraw, and those who are committed to college appear more frequently to persist (Astin 1975; DeBoer 1985; Fetters 1977; Hackman and Dysinger 1970; Kamens 1971; Lenning 1982; Mark 1967). Motivational level as measured by expectation, according to Marks (1967), is associated with students' level of aspiration, fear of failure, and parental attitudes. Astin (1975) found that expectations of "temporarily" dropping out are significantly correlated with dropping out for white males and blacks in white colleges. As stated by Rossman and Kirk (1970), this may simply be a "self-fulfilling prophecy" effect because they find the same result for both females and males in a single institution study. Counseling and advising services on this issue, as suggested by Fetters (1977), need to start at the pre-college level.

Commitment to college has been found to be a unique determinant of the prediction of dropping out (Hackman and Dysinger 1970). Hackman and Dysinger also found that the relationship between academic competence and commitment is likely to interact in predicting withdrawal.

Reasons for Attending College

The synthesis between Slater's (1957) hypothesis and Hackman and Dysinger's (1970) model suggests that when the decision to attend college is made by someone other than the

student then low commitment may result, and the likelihood of dropping out may increase. Iffert (1957), on the other hand, found that reasons for attending college are not significant to differentiate dropout from nondropout groups.

Vocational and Occupational Goals

Lenning's (1982) review concludes that a positive correlation exists between this variable and persistence, but it is found only for students in technical and vocational programs. This result supports the previous study by Iffert (1957). Other reviewers point out the importance of having a vocational goal to motivate students to choose a particular program, and therefore to persist in college (Frank and Kirk 1975; Hanson and Taylor 1970; Sexton 1965). Abel (1966), and Panos and Astin (1968) found that dropouts are more likely to declare their career occupation in the early stage of their education. However, some other studies have found no substantial effects of vocational goals on withdrawal (Barger and Hall 1965; Schmid and Reed 1966). In commenting on these inconsistent results, Pantages and Creedon 1978) point out the need to review the existing measurement methods on vocational goals in future research.

Educational Interests

Demitroff (1974) found that students who withdraw or canceled registration are less satisfied with their major

field of study than are persisters. This dissatisfaction has been associated with the frequency of changes in the students' majors. Changing majors has been cited as an indicator of uncertainty in a student's educational goals which in turn can lead to dropping out (Waterman and Waterman 1972). As reported by Iffert (1957), 55 % of undergraduate students have experience with changing their major at least once.

Parental Aspirations

Several studies have found a significant relationship between parental aspirations and student withdrawal (Lenning 1982). A summary by Sexton (1965) concludes that there is a significant relationship between parental aspirations and student's achievement motivation. Other familial factors have also been found important in establishing the student's level of motivation (Hackman and Dysinger 1970; Johnson 1970; Trent and Ruyle 1965). Contrary to these findings, however, Barger and Hall (1965), and Rossmann and Kirk (1970) found no substantial relationship between parental aspirations and student withdrawal.

In the face of this conflicting evidence, Pantages and Creedon (1978) offer an explanation. They propose the quality of the student-parents relationship as the mediator between parental aspirations and student withdrawal. Thus, parental aspirations will have more of an influence on the

student's withdrawal decision when the student-parents relationship is better.

Personality Factors

Complex relationships, as indicated by inconclusive findings, have been found between student personality factors and the likelihood of attrition (Lenning 1982). This is a problem similar to that discussed in connection with motivational factors; that is, in the use of measurement methods. Using the available personality tests, several personality-attrition studies have failed to differentiate dropouts from persisters (Williams 1966). However, many researchers have suggested to include personality factors in withdrawal studies (Pantages and Creedon 1978; Sexton 1965). This section will examine the role of personality traits and personality differences.

Personality Traits

Various personality traits have been investigated in the context of college dropout decisions. The following personality traits are usually identified as factors contributing to failure: aloofness, assertiveness, a tendency to be too critical, disagreeable, immature, impulsive, impetuous, nonconforming, rebellious against authority or self-centered. A lack of self-reliance, uncertainty about the future, and uncooperativeness also make failure more likely (Astin 1965; Blanchfield 1971;

Freedman 1956; Hannah 1969, Johnson 1970; Maudal, Buthcher, and Mauger 1974; Rose 1965; Sexton 1965; Summerskill 1962; Vaughan 1968).

Personality Differences

Rose and Elton (1966) found significant personality differences between groups of students. In their study, instead of using the usual "dropout" and "persister" distinction, Rose and Elton place students into four groups: successful persisters, probation persisters, defaulters, and dropouts. Among their findings, they report that dropouts are significantly more hostile than defaulters or either group of persisters. Rossman and Kirk (1970) also found the same results. However, several studies have been unsuccessful to show the importance of personality differences among the four groups (Johansson and Rossman 1973; Waterman and Waterman 1972).

Institutional Environment Factors

College environment has also been found to influence student withdrawal rates (Astin 1975). Institutional factors that have been investigated are institutional size, the type of institution and who controls it, selectivity of entering the institution, housing for student, student-faculty relationships, and extracurricular activities.

Institutional Size

Several studies have found a positive correlation between institutional size and the rate of withdrawal (Nelson 1966; Panos and Astin 1968). Kamens (1971) showed, however, that large institutions have better retention rates for medium and high-ability students. Other studies have reported no consistent relationship between institutional size and persistence (Astin 1975; Lenning 1982).

Type and Control

In his review, Lenning (1982) finds that withdrawal rates at private colleges are lower than those at public colleges. The same result is also obtained by Astin (1975). Moreover, Lenning (1982) and Astin (1975) report that four-year colleges tend to have lower withdrawal rates than two-year colleges.

Selectivity

Astin (1975) found that institutions with a high level of selectivity, as measured by SAT score requirements, experience lower withdrawal rates. This finding is also consistent with other studies (Lenning 1982). According to Lenning (1982), the reason is that students at highly selective institutions tend to have higher opportunity costs that discourage dropping out.

Housing

Many studies have reported that students living on-campus tend to have lower attrition rates than those who live off-campus (Astin 1975; Lenning 1982; Pantages and Creedon 1978). These studies also report that living in sororities and fraternities tends to reduce the probability of dropping out.

Student-Faculty Relationships

Pascarella and Terenzini (1977), using a multivariate analysis, found that informal student-faculty contact has a significant relationship with attrition. This finding parallels earlier findings by Hannah (1969), Rossman (1967), and Slocum (1956). Specifically, they report that the dropouts are more dissatisfied with faculty relationships than the persisters. Other studies have also found strong evidence that supports the existence of the relationship between student-faculty contact and college persistence (Ferguson 1990; Pascarella and Terenzini 1977, 1979; Spady 1971; Terenzini and Pascarella 1978). Several reviews have validated this relationship (Pascarella 1980; Terenzini and Pascarella 1980). However, a more recent study by Mallette and Cabrera (1991) indicates no significant differences in student-faculty interactions between the dropouts and the persisters.

Extracurricular Activities

Several studies observed that dropouts tend to participate less in extracurricular activities (Schmid and Reed 1966; Tinto 1975). The same observation is also obtained by Lenning (1982). In this context, Astin (1975) pointed out that membership in social fraternities or sororities is significantly related to persistence.

Financial Factors

The importance of financial factors in dropping out has long been observed by scholars (Summerskill 1962). It was reported as one of the three most important factors in attrition. In this context, the issue is how the source of financial aid such as scholarships, loans, grants, and parents' support relates to withdrawal.

Astin (1975) found that scholarships and dropout rates are negatively correlated for scholarships awarded on merit. The same result is also obtained by Blanchfield (1971).

Several studies have found that loans have no relationship with persistence (Blanchfield 1971; Herndon 1984). Astin (1975) found, on the other hand, that a negative effect of loans on attrition only appears to exist for males.

Astin's (1975) study showed that grants have a positive relationship with persistence. This finding is different from the previous findings that no relationship exists between receiving grants and persistence (Iffert 1957).

A more recent study also supports Iffert's finding (Herndon 1984). In addition to grants, Astin (1975) also found that parents support has a significant positive effect on persistence.

Student Withdrawal Models

There have been many attempts to derive theoretical models for student withdrawal from higher education. Bean (1982a) has reviewed the available models and grouped them into six types of models. Three of these models are of interest to this study and will therefore be examined in this section. The first is Spady's (1970) model which relates the withdrawal process to Durkheim's (1951) model of suicide. Then, Tinto (1975), building on the earlier work of Spady (1970, 1971), developed a theory explaining the process that motivates student to withdraw. The third model is Bean's (1980) which is based on studies of turnover in work organizations. In Bean's model, path analysis is incorporated to test the causal relationships presumed to exist among the variables.

Spady's Model

Most withdrawal studies prior to 1970 are of the descriptive type relying mostly on simple correlations. These studies are atheoretical because they are not based on a theory that explains why variables are correlated. The first theoretical model on student withdrawal was introduced

by Spady in 1970. This model is highly congruent with the concept of social integration of Durkheim (1951). According to Spady, dropout decisions are the result of a longitudinal process. And this process is best explained by examining the interaction between the individual student and the surrounding college environment. In designing his model, Spady uses 9 variables in explaining the dropout decision. The central variables in this model are grade performance, friendship support, intellectual development, social integration, satisfaction, and institutional commitment. Family background which functions as the foundation of the model is assumed to have a direct influence on both academic potential and normative congruence. Normative congruence and friendship support, which are taken from Durkheim (1951), together with grade performance and intellectual development are expected to increase social integration. It is further shown that social integration and dropout decision are linked indirectly. Intervening variables between social integration and dropping out are satisfaction and institutional commitment. The latter is expected to have a negative correlation with the dropout decision. In addition, unlike other variables, grade performance should be considered as an absolute condition for the student to withdraw. Finally, the feedback from institutional commitment to normative congruence shows the dynamics of the model.

In testing his model, Spady (1971) used longitudinal data from all 683 first-year students at the University of Chicago in 1965. He found that the contribution of all independent variables in predicting dropout was 0.31 for males and 0.39 for females, as measured by the R . Specifically, it was found that institutional commitment is the most important contributor for females to withdraw, whereas for males it is grade performance. But Spady also recognized the limitations of his findings; that is, different results might be obtained if this model is applied to higher education institutions characterized by different selectivity levels.

Tinto's Model

One of the attrition models that is most widely cited and empirically tested is Tinto's (1975) model (Aitken 1982; Baumgart and Johnstone 1977; Bean 1980, 1982b, 1985; Christie and Dinham 1991; Fox 1986; Getzlaf et al., 1984; Kember 1989; Munro 1981; Nora 1987; Pascarella and Chapman 1983a; Pascarella and Terenzini 1979, 1980, 1983; Pascarella et al., 1986; Terenzini and Pascarella 1977, 1978). The test results have generally confirmed the predictive validity of the Tinto model as well as the importance of its two central concepts of academic and social integration.

Like Spady's (1970) model, Tinto's model has its roots in Durkheim's (1951) theory of suicide. According to Tinto (1975, 94), a student's withdrawal from college can be

considered ". . . as a longitudinal process of interactions between the individual and the academic and social systems of the college . . . which lead to persistence and/or to varying forms of dropout." Tinto's theory argues that interactions between personal attributes and background characteristics (i.e., gender, socioeconomic status, ethnicity, and precollege ability) will lead to initial student commitments to educational goals and to specific institutions. These initial goals and institutional commitments are expected to influence the way a student chooses an institution.

Initial commitments, together with personal attributes and background characteristics, interact with the academic and social components of the institution to produce varying levels of academic and social integration. The levels of academic integration, according to Tinto (1987), are determined by the student's academic performance as well as his or her interactions with faculty and staff. Social integration, on the other hand, reflects the student's involvement in extracurricular activities and peer-group relations. Hence, the theory argues that, other things being equal, the greater the individual student's levels of integration into the academic and social systems of the college, the greater his or her commitment to the specific institution and to the goal of college completion. These new levels of commitments, in turn, are expected to have a

direct effect on decisions to withdraw from the institution. In this context, either low commitment to the goal of college completion or low commitment to the institution can lead to dropout. In addition, low levels of these commitments can also be used to distinguish between academic dismissal and voluntary withdrawal.

Tinto (1982b) acknowledged the limitations of his model by noting four major issues that had not been adequately investigated: (1) the role of finances in persistence, (2) determinants of persistence in two-year colleges, (3) group-specific differences in persistence (i.e., gender, race, and social status backgrounds), and (4) determinants of various voluntary withdrawal behaviors. Several studies related to some of these issues have been reported recently. Braxton, Brier, and Hossler (1988), Mallette and Cabrera (1991), and Metzner and Bean (1987) investigated the role of finances in persistence in four-year colleges. Anderson (1981), Nora (1987), Pascarella, Smart, and Ethington (1986), and Voorhees (1987) explored the determinants of persistence in community colleges. A national longitudinal study by Anderson (1981) finds that students who enter two-year community colleges are more likely to drop out than their peers entering four-year institutions. Nora (1987) reported the effects of gender and ethnicity for the two-year sector as well as Pascarella and Terenzini (1980), and Stage

(1988,1989b) for the four-year sector. Tinto (1987) examined the determinants of various withdrawal behavior.

To sum up, Tinto's model contains the same elements as that of Spady's. But the relationship among the variables is more linear in this model than in Spady's.

Bean's Model

Critique of previous models (Spady 1970; Tinto 1975) has been expressed by Bean (1980). He pointed out that concern of most studies was primarily on the correlates of student attrition rather than on its determinants. He also noted that variables used in the previous models were defined in such a way that made the models unfit for path analysis. In addition, the lack of a theoretical base has also been blamed as one of the reason why many of the past attrition studies are inconclusive.

Unlike Spady's (1970) and Tinto's (1975) models which are based in part on Durkheim's theory of suicide (1951), Bean's model is derived primarily from the work of Price (1977) on organizational turnover. It is a causal model which purports to investigate the determinants of student attrition. The model contains 28 variables which can be grouped into four categories of variables. These are dropout as the dependent variable, satisfaction and institutional commitment as the intervening variables, the organizational variables, and the background variables.

To test this causal model of student attrition, two statistical methods are used. These methods are multiple regression and path analysis. Multiple regression, as usual, is intended to provide an assessment of the partial and overall influence of the independent variables on the dependent variable. Path analysis (Heise 1969; Land 1969), on the other hand, is used to investigate whether the causal relationships assumed to exist among the variables in the model are significant. Path-analytic techniques have been widely used to study attrition (Munro 1981).

Using a sample of 907 freshman students, Bean's analysis suggests that institutional commitment is the primary variable affecting withdrawal. It is interesting to note that this finding is consistent with the previous studies (Spady 1970; Tinto 1975). But overall, the explanatory power of the model in predicting withdrawal behavior is quite low as measured by the adjusted R of 0.21 for females and 0.12 for males. These results are comparable with the attrition studies of Bayer (1968), Panos and Astin (1968), Peng and Fetters (1978), and Munro (1981) with the R ranges from 0.09 to 0.14. But it is lower than Spady's finding with an unadjusted R of 0.39 for females and 0.31 for males.

Path analysis which is used to assess the importance of an independent variable in influencing the dependent variable shows and confirms the multiple regression result

that institutional commitment is the most important indicator of dropout. The result of path analysis is usually expressed in terms of standardized regression coefficient or beta weight. A negative (positive) sign of the beta weight indicates a negative (positive) relationship between the independent variable and the dependent variable. As measured by total causal effect, for females, institutional commitment accounts for -0.47, and for males -0.29. For a comparison, the second most important variable is performance for females, and university grade point average for males with total causal effects of -0.14 and -0.15 respectively.

CHAPTER III

METHODOLOGY

A Simple Model of Course Withdrawal

Various elements can be taken from Spady's (1970), Tinto's (1975), and Bean's (1980) studies to form a simple model of course withdrawal. The proposed model, as illustrated in Figure 1, contains 17 variables that can be grouped into four categories of variables: the student attributes variables, the pre-semester background variables, the class attributes variables, withdrawal decision as the dependent variable, and satisfaction as the intervening variable.

Satisfaction has often been viewed in the literature as one of the most important intervening variables influencing intent to leave (Bean 1980; Cooper and Bradshaw 1984; Price 1977; Spady 1970; Tinto 1975). A discussion of the model follows.

Student Attributes

Student attributes represent facts about students which include factors such as gender, age, and ethnicity. The importance of these factors in explaining the dropout behavior have been discussed at length in the previous chapter. Using the same argumentation, it is hypothesized

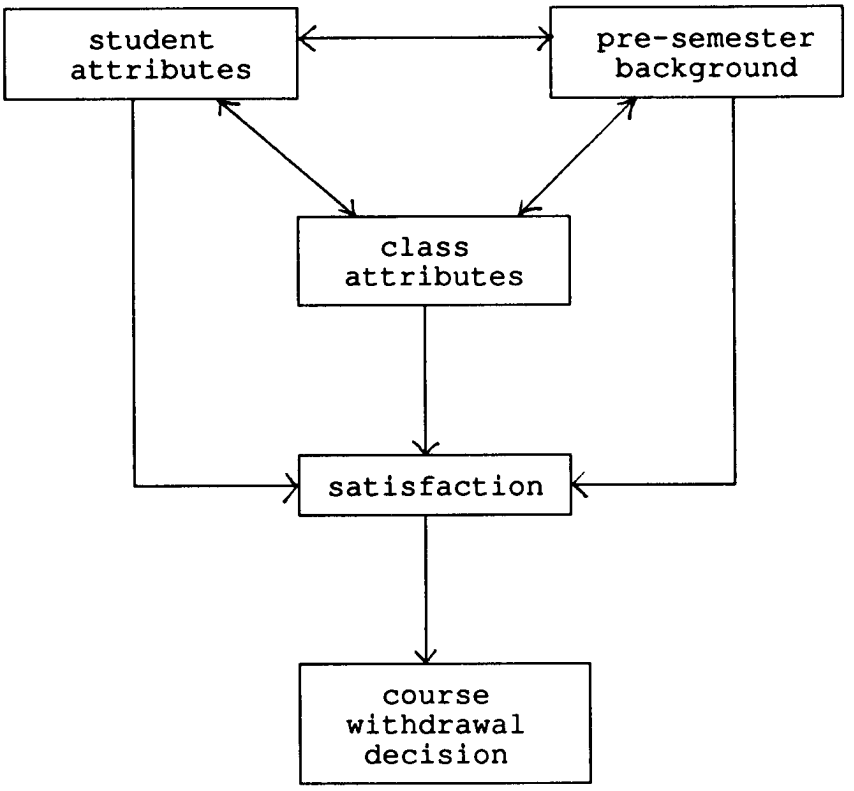

Figure 1. A Model of Course Withdrawal

that these factors are also significant determinants of student course withdrawals. The most important of these factors or variables is probably age since it is intuitively assumed that the maturity of the student has a negative effect on withdrawal. In the case of older returning students, it was found that they outperform younger students (Leppel 1984). Adams and Becker (1990) found, however, that age is positively correlated to withdrawal in one of the four principles courses they observed.

The second most important factor in this category is ethnicity. In a predominantly white institution, such as Middle Tennessee State University, other ethnic groups often find themselves in the position of a distinct minority. They may feel that they are unwelcome by the white students (Kraft 1991). Loo and Rolison (1986) have found that feelings of ethnic isolation for minority students are greater than for white students. This sense of isolation may lead minority students to withdraw not only from courses but also from the institution (Tinto 1988). In addition, as far as the institution is concerned, students' satisfaction is found to be significantly different between black and white students (Allen 1987; Nettles, Thoeny, and Gosman 1986).

Gender differences as the third factor are expected to have a significant relationship with course withdrawal. Bridgeman and Wendler (1991) found that females outperform

males in mathematics course grades. Lumsden and Scott (1987) also found that females perform better than males on economics essay tests. But Martin and Bender (1985) failed to support Lumsden and Scott's finding. However, Adams and Becker (1990) found no significant correlation between gender differences and course withdrawal.

Pre-Semester Background

Pre-semester background indicates facts about students at the beginning of the semester. Included among these variables are cumulative credit hours completed previously, coefficient of completion as measured by the ratio of cumulative credit hours completed to cumulative credit hours attempted, transferred credits, financial aid, attempted credits during the semester, athlete scholarship, owe money to university, financial aid, and previous cumulative GPA.

The number of credits completed previously is expected to have a negative relationship with withdrawal. Following Adams and Becker (1990), the coefficient of completion is used as a proxy for the student's future withdrawal rate. Transferred credits enter the model since almost 50 percent of the new undergraduates are transfers. The more outside credits are transferred by an individual student, the more likely for him or her to choose other alternatives to complete courses.

Financial aid has been reported by many studies as one of the most important factors affecting attrition, and hence

it is also expected to influence course withdrawals. This financial aid includes grants, loans, scholarships, and family support.

To measure student motivation, two variables are used: attempted credits at the end of drop-add period and expected graduation year. It is argued that the more credits a student attempts in a semester, the more likely he or she will be to withdraw because of overcommitment. However, the closer a student is to graduation, the more likely will he or she persist.

The model also considers those students who receive athlete scholarships, since most of them are freshman and sophomore students taking principles courses. The net effect of time constraint to study and extensive advising, tutoring, and counseling received by these students will be a crucial determinant in the course withdrawal decision.

Finally, to measure grade expectation, which is assumed to negatively affect satisfaction, and hence withdrawal decision, previous cumulative grade point average is used as a proxy. Thus, previous cumulative grade point average is expected to negatively influence withdrawal decision. Pike (1991) demonstrated, however, that the opposite causal direction is also possible, that is, satisfaction influences grades.

Class Attributes

Class attributes are variables over which the student has little or no control. These include class size, instructor experience, instructor gender, and course scheduling. Class size is expected to be positively correlated with course withdrawal. It is assumed that in large classes, interaction between students and instructor is most likely to be weak. A negative effect of large classes on student performance has been reported by Raimondo, Esposito, and Gershenberg (1990). McConnell and Sosin (1984) also demonstrated that student attitudes toward large classes are significantly negative. Adams and Becker (1990) show, however, that course enrollment is not significantly related to course withdrawal.

More experience on the part of instructors (i.e., professor, associate professor, assistant professor, graduate student instructor) should lower the likelihood of course withdrawals. The quality of an instructor has been found to be significantly related to student satisfaction (Chadwick and Ward 1987), which in turn determines the withdrawal decision. Student-oriented instructors have also been found to significantly increase student satisfaction (Strom et al. 1990). A related issue not addressed here is whether a difference exists between graduate student instructors for whom English is a second language and those whose first language is English (Becker et al. 1991). In

this context, Watts and Lynch (1989) report a negative and significant relationship between student performance and non-native English speaking instructors. In addition to experience, instructor gender may also contribute to course withdrawal.

Finally, course scheduling may also have some effect on course withdrawal. It is divided into three categories: morning, afternoon, and night classes. In this context, afternoon classes are expected to have a positive relationship with course withdrawals. Ward and Gowan (1989) found that there is a significant difference in withdrawals of students in a course with classes meeting on different days of the week.

Intervening Variable

Interaction between student attributes, pre-semester background, and class attributes produces varying levels of satisfaction. If the level of satisfaction a student receives from a course is less than a particular threshold level, he or she is most likely to withdraw from the course in question. In this study, no intervening variable as measured by satisfaction is observable. The reason is that this study does not contain attitudinal assessments, it only deals with facts. What is actually observed is not satisfaction but course withdrawal.

Withdrawal Decision

The dependent variable is withdrawal decision as measured by course withdrawal. This variable is an observed binary variable that takes only two values: withdraw or not. This observed binary variable is a function of a continuous variable satisfaction. This function is a perfect function but it is not linear (Kim and Rabjohn 1980). Satisfaction is, in turn, a function of the independent variables: student attributes, pre-semester background, and class attributes. The concern of this study is to examine the relationship between the observed binary variable and the independent variables. The statistical methods that handle this kind of relationship are discussed in Appendix C.

Institutional Background

This is a single institution study conducted at Middle Tennessee State University, Murfreesboro, Tennessee. The university has had a rate of growth in enrollment more than five percent per year since 1987, and it is, in fact, the fastest growing university in Tennessee.

During the Fall and Spring semesters of academic year 1990-1991, on average, 14,500 students enrolled in each semester. Seventy-five percent of these students are full-time and the majority is female (54%). New undergraduates account for 23 % and this includes 10 % transfers. The average age of students is 24 years. The average returning

rate for these semesters is 80%. White students form the largest racial subgroup on campus (87%), followed in magnitude by Blacks (9%), Asians (2%), Hispanics (1%), and American Indians (0.2%). In addition, 35 % of these students enroll in evening classes.

Design and Sample

The overall study design is cross-sectional and is based on actual behavior. The study includes two cohorts of students: Fall 1990 entrants and Spring 1991 entrants. Data for the two cohorts are analyzed separately in order to determine whether the results for the first cohort would be replicated with the second.

The study is focused on students who take any of the four major principles courses (i.e., Biology, Economics, Mathematics, Psychology) during that period. These courses are listed as BIOL 100 for Biology, ECON 241 and ECON 242 for Economics, MATH 141 for Mathematics, and PSY 141 for Psychology. Data are provided by the MTSU Computer Services Department. Students in each course are treated as a separate record.

Statistical Analysis

The purpose of this study, as can be seen from the model developed, is to determine which of the independent variables are significantly related to course withdrawal.

It has been noted previously that the dependent variable is a binary variable; therefore the model should not be analyzed using the General Linear Model (GLM) approach. Appendix C discusses the problem that arises from using GLM.

A large literature exists on binary choice models (e.g., Dhrymes 1986; Greene 1989; Maddala 1983; Pindyck and Rubinfeld 1981). Analysis methods that are most widely used for binary models are the probit and the logit (Becker and Waldman 1989; DeCanio 1986; Mallette and Cabrera 1991; Mehdizadeh 1990; Ott 1988; Park and Kerr 1990; Schmidt and Strauss 1975; Spector and Mazzeo 1980; Stage 1989a). These methods not only outperform the GLM but they avoid violations to the assumption of homoscedasticity that would as usually result from the use of GLM for dichotomous-dependent variables.

Two regression methods are applied in this study. First, the logit regression is used to investigate the relationship between the dependent variable (i.e., withdrawal decision) and the independent variables. For comparison, however, results of the probit and the ordinary least squares (OLS) method are also presented. Second, OLS is used to determine whether students who withdraw from courses are less successful than students who do not withdraw. A discussion of the probit and the logit is presented in Appendix C.

CHAPTER IV

ANALYSIS OF DATA AND ESTIMATION RESULTS

Variables

The theoretical model of student course withdrawals suggested in the previous chapter uses the following variables. The dependent variable is student satisfaction. But, since student satisfaction is not observable, it is measured by course withdrawal (WITHD). The independent variables are grouped into three categories: student attributes, pre-semester background, and class attributes variables.

Student attributes variables are gender (STDGDR), age (AGE), and ethnicity (ETHN1 = Asian; ETHN2 = Black; ETHN3 = Hispanic). Since no dummy variable is specified for white students, these variables measure the difference between white and non-white students. Other ethnic backgrounds are not represented sufficiently in the data sample, and hence do not enter the model.

Pre-semester background variables include transfer credits (TRSCRD), cumulative grade point average (CUMGPA), current credits attempted (CURCRD), athlete scholarship (ATHLT), financial aid (FINAID), owe money to the university (OWE), cumulative hours completed (CUMHRS), and completion

coefficient as the ratio of cumulative hours completed to cumulative hours attempted (CPLCOF).

Class attribute variables consist of class meeting time (MEET1 = afternoon; MEET2 = evening), class size (CLASIZ), instructor experience (EXPER1 = asistant professor; EXPER2 = graduate teaching assistant), and instructor gender (INSGDR). Since no variable is assigned for morning class meetings, the coefficients for MEET1 and MEET2 will identify whether there is a difference between morning classes and other classes. For instructor experience, this study hypothesizes that a lack of teaching experience is the most likely factor for course withdrawals. Only two rankings of intructors enter the model. The coefficients for these two variables will measure to what extent little instructor experience has an effect on course withdrawals. A complete list of variables is provided in Appendix B.

Descriptive Results

Descriptive statistics on means and standard deviations for the variables used in this study are presented in Tables 1 and 2. For the Fall semester 1990, the WITHD variable indicates that only 1.75% of the 1143 students in Psychology withdrew while in Mathematics 8.19% of the 1025 student withdrew. The same pattern follows for the Spring semester 1991; the rate is 1.48% of the 944 students in Psychology as compared to 6.81% of the 925 students in Mathematics. High

withdrawal rates for Mathematics were also reported by Adams and Becker (1990).

It is interesting to note in Tables 1 and 2 that students in Economics have a higher average age (21.63) than students in the other three courses; yet the average cumulative GPA of Economics students (2.36) is higher than those of others. This suggests that older students are more effective in the course selection, as shown in the next section, and are expected to have a lower course withdrawal rate.

The coefficients of completion as measured by the ratio of cumulative hours completed to cumulative hours attempted are about the same across all the courses (ranging from 56% to 58%). This means that students have approximately the same level of course completion background as they enter the Fall 1990 and Spring 1991. However, the average GPAs for the Fall semester for all courses are relatively higher than those for the Spring semester.

Regression Results

Logit regression analysis is used to determine which of the independent variables are significantly related to course withdrawal. A separate regression is run for each course for both Fall 1990 and Spring 1991, as shown in Tables 3 and Tables A1-A7 of Appendix D. For a comparison, however, OLS and probit results are also presented.
A summary of the logit results is then provided in Tables 4

Table 1. Descriptive Statistics for Fall 1990
(Mean over Standard Deviation)

Variable	Economics	Biology	Mathematics	Psychology
N	1048	1278	1025	1143
WITHD	0.0487	0.0368	0.0820	0.0175
	0.2153	0.1883	0.2744	0.1312
ETHN1	0.0199	0.0110	0.0156	0.0149
	0.1369	0.1041	0.1240	0.1211
ETHN2	0.1107	0.1150	0.1015	0.1277
	0.3139	0.3192	0.3021	0.3339
ETHN3	0.0048	0.0078	0.0049	0.0088
	0.0689	0.0882	0.0697	0.0932
STDGDR	0.5468	0.4914	0.4849	0.4681
	0.4981	0.5001	0.5000	0.4992
AGE	21.6326	20.2567	20.5620	20.6439
	4.4348	3.9766	3.9259	4.3149
ATHLT	0.2863	0.3169	0.2966	0.3053
	0.4522	0.4655	0.4570	0.4608
OWEMO	0.2691	0.3740	0.3746	0.3421
	0.4437	0.4841	0.4843	0.4746
FINAID	0.1269	0.1870	0.1620	0.1759
	0.3330	0.3901	0.3686	0.3809
CUMHRS	47.4714	33.6956	37.2127	32.6221
	34.0228	24.2644	26.8658	25.9953
CPLCOF	0.5669	0.5608	0.5704	0.5604
	0.2517	0.2217	0.2253	0.2354
TRSCRD	0.3998	0.3279	0.4049	0.5468
	2.7276	1.9155	2.3562	4.3905
CUMGPA	2.3602	2.3148	2.3017	2.1777
	0.7634	0.8234	0.8178	0.8581
CURCRD	12.9313	14.2966	13.6185	13.4698
	3.5371	2.5813	3.0663	2.9658
CURGPA	2.3282	2.3346	2.3103	2.2531
	0.9442	0.9165	0.9615	0.9781
MEET1	0.1498	0.1925	0.4976	0.0665
	0.3571	0.3944	0.5002	0.2493
MEET2	0.1069	0.1080		0.0385
	0.3091	0.3105		0.1925
CLASIZ	57.9704	26.4421	29.7981	128.6299
	26.9091	2.5432	3.3032	76.5679
EXPER1	0.4113	0.4280	0.3424	0.2109
	0.4923	0.4950	0.4748	0.4081
EXPER2	0.2328		0.4273	
	0.4228		0.4949	
INSGDR		0.1768		0.3377
		0.3817		0.4731

Table 2. Descriptive Statistics for Spring 1991
(Mean over Standard Deviation)

Variable N	Economics 1036	Biology 987	Mathematics 925	Psychology 944
WITHD	0.0270	0.0415	0.0681	0.0148
	0.1622	0.1996	0.2521	0.1209
ETHN2	0.0193	0.0182	0.0141	0.0117
	0.1377	0.1339	0.1178	0.1074
ETHN3	0.1313	0.1297	0.1362	0.1314
	0.3379	0.3361	0.3432	0.3380
ETHN4	0.0068	0.0061	0.0054	0.0085
	0.0820	0.0778	0.0734	0.0917
STDGDR	0.5753	0.4924	0.5016	0.4862
	0.4945	0.5002	0.5003	0.5001
AGE	22.0299	21.8683	21.5978	21.4470
	3.8886	4.0019	4.1344	3.8615
ATHLT	0.3263	0.3344	0.3470	0.3824
	0.4691	0.4720	0.4763	0.4862
OWEMO	0.3002	0.2938	0.3081	0.2818
	0.4586	0.2938	0.4620	0.4501
CUMHRS	42.4431	37.6687	36.2995	31.1134
	29.4356	27.5944	27.4444	26.1260
CPLCOF	0.5793	0.5742	0.5754	0.5659
	0.2393	0.2387	0.2177	0.2318
TRSCRD	3.6149	4.2320	2.4638	2.7828
	12.9665	14.0959	10.0401	10.9336
CUMGPA	2.3454	2.2959	2.1769	2.1880
	0.7936	0.8078	0.8046	0.8689
CURCRD	13.2404	13.9899	13.3287	13.2680
	3.4707	2.7851	2.8815	3.0751
CURGPA	2.2545	2.2234	2.1205	2.1871
	0.9977	0.9999	1.0089	1.0311
MEET1	0.1998	0.2401	0.3070	0.1939
	0.4001	0.4274	0.4615	0.3955
MEET2	0.0763	0.0699		0.0350
	0.2655	0.2551		0.1838
CLASIZ	55.7925	24.3414	38.6638	116.3453
	25.3282	0.9415	3.6837	56.7797
EXPER1	0.3977	0.5502	0.2789	0.1939
	0.4897	0.4977	0.4487	0.3955
EXPER2	0.2423		0.6530	
	0.4287		0.4763	
INSGDR		0.2888		0.3125
		0.4534		0.4638

and 5. Finally, to see whether course withdrawal has an impact on student success, current grade point average (CURGPA) is regressed on course withdrawal (WITHD). Table 6 and Table 7 present the OLS results of the effect of course withdrawal on student success.

The OLS-Probit-Logit Comparison

It is useful to compare the results obtained from applying ordinary least squares (OLS) to those derived with the probit and the logit. The results are presented in Table 3 and Tables A1-A7 of Appendix D. These results have been adjusted to make them comparable. The coefficients of the logit are left as they are computed. The coefficients of the probit are multiplied by 1.6. The coefficients of the OLS are multiplied by four and then two is substracted from the constant (Maddala 1988).

As predicted by econometric theory, OLS will produce biased results while the probit and the logit generate results that are rather close. Table 3 shows in fact, that OLS produces more significant variables than the probit and the logit approach. The probit and the logit, on the other hand, produce about the same results. Since theoretically the OLS method is not appropriate for use in the binary model, it will not be considered any further in the next discussion. It should be noted here, however, that OLS estimates are used as starting values for both the probit and the logit analyses.

All of the probit and logit models used in this study fit well with statistical significance levels far below the 0.01 level. The chi-squared value of 0.01 at the bottom of Table 3 means that, taken together, all coefficients are significant at the one percent level. The chi-squared test is equivalent to F-test in standard OLS regression analysis. Asymptotic t-tests are reported in parentheses below the estimated parameters.

Several differences, although not statistically significant, are found for the signs of the probit and the logit coefficients. Specifically, as shown in Table 3, the regression coefficients for ETHN2 are -0.02 and 0.05 for the probit and the logit respectively. There are also some minor differences in Tables A1-A7 of Appendix D.

As far as the overall level of significance is concerned, both the probit and the logit produce the same results at the 0.01 and 0.05 level. This finding confirms the theoretical expectation that probit and logit models produce similar results. At the 0.10 level, however, this study finds more significant results for the logit than the probit.

Finally, as shown in Tables 4 and 5, a comparison between the probit and the logit in terms of pseudo-R^2 and count-R^2 measures (Maddala 1988, 279) also indicates that there is not much to choose between those two approaches.

Table 3. Regression Results for Economics, Fall 1990
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	-0.45	5.10	8.45
	(6.07)	(3.14)	(3.44)
ETHN1	-0.10	-5.89	-14.32
	(-0.52)	(-0.01)	(-0.01)
ETHN2	0.01	-0.02	0.05
	(0.14)	(-0.05)	(0.11)
ETHN3	-0.25	-6.22	-14.94
	(-0.66)	(-0.01)	(0.00)
STDGDR	-0.03	-0.01	-0.04
	(-0.49)	(-0.03)	(-0.11)
AGE	-0.03	-0.24	-0.39
	(-3.84)	(-3.94)	(-3.78)
ATHLT	-0.05	-0.17	-0.31
	(-0.82)	(-0.59)	(-0.78)
OWEMO	0.11	0.41	0.55
	(1.88)	(1.63)	(1.69)
FINAID	-0.04	-0.35	-0.48
	(-0.45)	(-0.85)	(-0.90)
CUMHRS	0.00	0.00	0.00
	(0.02)	(0.51)	(0.54)
CPLCOF	-0.04	-0.58	-0.82
	(-0.29)	(-0.79)	(-0.85)
TRSCRD	0.00	-0.02	-0.02
	(-0.20)	(-0.29)	(-0.25)
CUMGPA	0.01	0.06	0.16
	(0.26)	(0.37)	(0.72)
CURCRD	-0.06	-0.25	-0.33
	(-6.84)	(-6.41)	(-6.74)
MEET1	0.09	0.48	0.72
	(0.98)	(1.22)	(1.42)
MEET2	-0.13	-0.16	-0.09
	(-1.29)	(-0.37)	(-0.15)
CLASIZ	0.00	0.00	0.01
	(0.23)	(0.47)	(0.69)
EXPER1	0.00	0.03	0.09
	(-0.04)	(0.08)	(0.21)
EXPER2	0.00	0.12	0.23
	(0.05)	(0.32)	(0.45)
Log-Likelihood.....		-171.46	-169.57
Restricted (Slopes=0) Log-L.		-203.90	-203.90
Chi-Squared (18).....		64.89	
Significance Level.....		0.21774E-07	

Interestingly, the pattern of pseudo-R^2 measure of the probit and the logit is similar for both the Fall 1990 and the Spring 1991 cohorts. This indicates that the models are replicated well for that period of study. In addition, the predictive power of the models as measured by count-R^2 shows that on average 96% of the results are correctly predicted.

Table 4. Pseudo-R^2 and Count-R^2 Measures for the Probit and Logit Models, Fall 1990

	Pseudo-R^2		Count-R^2	
	Probit	Logit	Probit	Logit
Economics	0.0327	0.0348	0.9642	0.9642
Biology	0.0853	0.0829	0.9632	0.9656
Mathematics	0.0370	0.0344	0.9112	0.9112
Psychology	0.0941	0.0936	0.9825	0.9834

Table 5. Pseudo-R^2 and Count-R^2 Measures for the Probit and Logit Models, Spring 1991

	Pseudo-R^2		Count-R^2	
	Probit	Logit	Probit	Logit
Economics	0.0419	0.0415	0.9730	0.9730
Biology	0.0745	0.0719	0.9605	0.9625
Mathematics	0.0457	0.0425	0.9276	0.9265
Psychology	0.1002	0.0978	0.9862	0.9862

The Logit Analysis

Tables 6 and 7 provide the summary of the logit parameter estimates of the course withdrawal models taken from Table 3 and Tables A1-A7 of Appendix D.

In all the courses for both Fall 1990 and Spring 1991, there is a significant and negative relationship between the number of credits attempted during the semester (CURCRD) and course withdrawal. This unexpected result indicates that students who take many credits tend to persist in their courses.

The logit also indicates that in both Fall 1990 and Spring 1991 there was an inverse relationship between student age (AGE) and withdrawal. For the Fall 1990, this relationship is found significant in Economics and Psychology; for the Spring 1991 it is significant in Economics and Mathematics. Thus, the older the student, the less likely is a withdrawal. This finding contradicts that of Adams and Becker (1990). The significant result for Economics for both semesters may be based on the fact that students taking Economics are relatively older and hence be more effective in choosing courses.

On the issue whether ethnicity correlates with course withdrawals, it is found that compared to white students Asian students (ETHN1) are more likely to withdraw in Psychology, and Black students (ETHN2) in Biology of Fall 1990. In Spring 1991, however, only Black students have

Table 6. Logit Results for Fall 1990
(Regression Coefficient over Asysmptotic T-ratio)

Variable	Economics	Biology	Mathematics	Psychology
Constant	8.45*	12.16*	1.89	8.91*
	(3.44)	(4.49)	(1.21)	(2.89)
ETHN1	-14.32	-15.08	-0.01	2.71***
	(-0.01)	(-0.01)	(-0.01)	(1.95)
ETHN2	0.05	1.05**	-0.72	0.37
	(0.11)	(2.40)	(-1.40)	(0.51)
ETHN3	-14.94	-13.80	-14.53	1.87
	(0.00)	(-0.01)	(-0.01)	(1.59)
STDGDR	-0.04	0.35	0.04	0.13
	(-0.11)	(0.96)	(0.16)	(0.24)
AGE	-0.39*	-0.02	-0.03	-0.24**
	(-3.78)	(-0.37)	(-0.88)	(-2.37)
ATHLT	-0.31	-0.07	-0.40	0.08
	(-0.78)	(-0.16)	(-1.19)	(0.12)
OWEMO	0.55***	-0.05	-0.19	0.78
	(1.69)	(-0.14)	(-0.67)	(1.36)
FINAID	-0.48	0.88***	-0.24	-0.29
	(-0.90)	(1.92)	(-0.58)	(-0.34)
CUMHRS	0.00	-0.01	0.02*	0.02
	(0.54)	(-0.92)	(3.11)	(1.09)
CPLCOF	-0.82	-0.49	-1.13	-2.91***
	(-0.85)	(-0.50)	(-1.52)	(-1.89)
TRSCRD	-0.02	0.07	-0.03	-0.06
	(-0.25)	(1.08)	(-0.50)	(-0.32)
CUMGPA	0.16	0.03	-0.51*	-0.05
	(0.72)	(0.13)	(-3.04)	(-0.15)
CURCRD	-0.33*	-0.60*	-0.27*	-0.60*
	(-6.74)	(-8.06)	(-6.97)	(-6.00)
MEET1	0.72	-1.24***	0.00	-0.80
	(1.42)	(-1.93)	(0.02)	(-0.83)
MEET2	-0.09	-3.73*		-18.57
	(-0.15)	(-3.90)		(-0.01)
CLASIZ	0.01	-0.30*	0.03	-0.01
	(0.69)	(-3.98)	(0.78)	(-1.28)
EXPER1	0.09	0.54	0.58***	1.03
	(0.21)	(1.47)	(1.74)	(1.29)
EXPER2	0.23		-0.23	
	(0.45)		(-0.65)	
INSGDR		-0.28		0.27
		(-0.60)		(0.37)

* significance at 1% level
** significance at 5% level
***significance at 10% level

Table 7. Logit Results for Spring 1991
(Regression Coefficient over Asymptotic T-ratio)

Variable	Economics	Biology	Mathematics	Psychology
Constant	10.10*	10.23**	10.22*	0.92
	(3.08)	(2.23)	(4.68)	(0.33)
ETHN1	1.34	0.94	0.73	-13.90
	(1.22)	(0.83)	(0.65)	(0.00)
ETHN2	-1.83***	-0.07	0.40	0.80
	(-1.70)	(-0.11)	(1.01)	(1.04)
ETHN3	-13.68	1.12	-12.01	-14.11
	(-0.01)	(0.88)	(-0.01)	(0.00)
STDGDR	-0.24	0.85**	0.16	0.21
	(-0.59)	(2.14)	(0.54)	(0.33)
AGE	-0.44*	-0.10	-0.14**	-0.01
	(-3.15)	(-1.60)	(-2.54)	(-0.08)
ATHLT	0.81***	-0.01	0.32	0.54
	(1.83)	(-0.02)	(1.02)	(0.77)
OWEMO	-0.19	-0.53	0.24	1.54**
	(-0.43)	(-1.21)	(0.78)	(2.29)
CUMHRS	0.01	0.01	0.03*	-0.01
	(1.33)	(1.33)	(4.65)	(-0.61)
CPLCOF	0.04	-1.61***	-3.63*	1.66
	(0.03)	(-1.66)	(-3.81)	(1.03)
TRSCRD	-0.22	-0.04	0.00	0.00
	(-1.10)	(-1.52)	(0.27)	(0.00)
CUMGPA	-0.13	-0.25	-0.05	-0.45
	(-0.46)	(-0.99)	(-0.21)	(-1.10)
CURCRD	-0.31*	-0.51*	-0.30*	-0.48*
	(-5.02)	(-7.07)	(-5.85)	(-5.10)
MEET1	-0.54	0.22	-0.17	-1.21
	(-0.87)	(0.48)	(-0.49)	(-0.94)
MEET2	0.38	0.09		-16.55
	(0.47)	(0.13)		(-0.01)
CLASIZ	-0.01	-0.19	-0.17*	0.00
	(-0.74)	(-1.05)	(-3.39)	(-0.27)
EXPER1	-0.49	-0.54	0.86	0.10
	(-0.96)	(-1.26)	(1.42)	(0.07)
EXPER2	-0.23		0.64	
	(-0.40)		(1.03)	
INSGDR		1.35*		-0.09
		(2.88)		(-0.10)

* significance at 1% level
** significance at 5% level
***significance at 10% level

a withdrawal rate in Economics that is statistically different from that of white students. It seems that ethnic background does not produce consistent results across all courses and semesters. The same conclusion was also reached by Adams and Becker (1990).

With the exception of Economics, the student's gender (STDGDR) tends to be correlated with withdrawals in that males are more likely to withdraw. But this relationship is statistically significant only in Biology and in the Spring of 1991. It is surprising that for the same semester, the gender of the instructor is found to have a significant positive relationship with withdrawals in Biology. Adams and Becker (1990), on the other hand, found a negative relationship between student gender and withdrawals in Biology. It should be noted that these variables are coded in the same way as in Adams and Becker. Thus, following Adams and Becker, it appears that student's and instructor's gender are not important determinants of student course withdrawals.

Contrary to common belief, there is a tendency that class size (CLASIZ) is inversely related to withdrawals. Significant relationships, however, are found only in Biology for the Fall of 1990, and in Mathematics for the Spring of 1991. Larger class size, such as in Psychology, has no relationship with withdrawals. Thus, it seems that

class size is of little importance in the withdrawal decision.

This study also finds that cumulative grade point average (CUMGPA) is negatively related to withdrawals. The exceptions are Economics and Biology of Fall 1990. The higher the students' cumulative grade point average, the less likely does a withdrawal occur. However, this negative relationship is significant only for Mathematics in the Fall of 1990. Thus, in general, no strong conclusion can be drawn about the influence of cumulative grade point average on the withdrawal decision.

The completion coefficient (CPLCOF) shows a negative relationship for all of the courses in the Fall of 1990. This negative relationship is significant in Psychology. The higher the completion coefficient, the less likely is a withdrawal. For Spring 1991, a significant negative relationship is found in Biology and Mathematics.

The variable cumulative hours completed (CUMHRS) appears to have a positive relationship with withdrawals. This result is unexpected. Students with more completed credits are more likely to withdraw. A positive significant relationship between cumulative hours completed and withdrawals, however, is found only in Mathematics for both semesters. Hence the CUMHRS variable may not be a major determinant of withdrawals.

Students who owe money to the university (OWEMO) are more likely to withdraw. Although the signs are not consistent across the courses, a significant positive relationship between OWEMO and withdrawals is found in Economics of Fall 1990, and in Psychology of Spring 1991. Again, no strong argument can be made for the OWEMO variable to be a crucial determinant of withdrawals.

With regard to class schedule, it appears that, only in Biology of Fall 1990, do afternoon classes (MEET1) and evening classes (MEET2) have a significantly negative relationship with withdrawals compared to morning classes. Students who attended afternoon or evening classes are more likely to withdraw. Although the tendency in general shows a negative relationship between class meetings late in the day and withdrawals, this relationship is more profound for the Fall semester of 1990. But it appears that these variables are not a crucial determinant in the withdrawal decision.

The results also reveal that there is a tendency for students who transfer credits (TRSCRD) to persist. This appears in Economics, Mathematics, and Psychology for Fall 1990, and in Economics and Biology for Spring 1991. A possible explanation of this effect is that students who transfer credits generally had more experience in selecting courses. Adams and Becker (1990), on the other hand, found an opposite result. Unfortunately, none of this and

previous studies is statistically significant. Hence this variable may not be a factor of course withdrawal determinants.

Students who receive scholarship (ATHLT) are less likely to withdraw in the Fall semester, but are more likely to withdraw in the Spring semester. This inconsistency implies that the ATHLT variable is not an influencing variable in the withdrawal decision. In addition, students who receive financial aid (FINAID) tend to persist in Economics, Mathematics and Psychology of Fall 1990 although this relationship is not significant at the ten percent level. In Biology, there may even be a significant positive relationship between financial aid and withdrawal.

The effect of instructor experience on withdrawals as shown by EXPER1 and EXPER2 is not consistent across the courses for both semesters compared to associate and full professors. Assistant professors (EXPER1) are more likely to be associated with withdrawals in all the courses of Fall 1990, although a significant relationship is found only in Mathematics. In Spring 1991, this relationship is positive in Mathematics and Psychology, but is negative in Economics and Biology. Finally, graduate teaching assistants (EXPER2) is not a significant predictor of course withdrawals in either semester. In Economics, a positive relationship is found between EXPER2 and withdrawals for Fall 1990, but a negative relationship is found for Spring 1991. In

Mathematics, on the other hand, a negative relationship is found for Fall 1990 and a positive relationship for Spring 1991. Therefore, a course that is taught by a graduate teaching assistant is unlikely to result in more withdrawals than a course taught by associate or full professors.

The Effect of Withdrawals on Student Success

Although the logit models fit well in this study as shown in the previous sub-section, it is also recognized that, individually, most of the independent variables are statistically insignificant as predictors of course withdrawals. Accordingly, as the follow up of the previous analyses, it is interesting to know, if there is any effect of course withdrawal on student success.

To investigate this question, current grade point average (CURGPA) is taken as the dependent variable. It is regressed on withdrawal (WITHD) as the independent variable. Since the CURGPA variable is not a binary variable, OLS can be used to produce the regression coefficients. Tables 15 and 16 present the results for both Fall 1990 and Spring.

Interestingly, for all of the courses in both semesters there is a negative relationship between withdrawals and current grade point average. Furthermore, with the exception of Psychology of Fall 1990 and Economics of Spring 1991, all other courses show a statistically significant relationship. A most likely explanation for

Table 8. Withdrawal Effect on Student Success, Fall 1990
(Regression Coefficient over T-ratio)

Method: OLS
Dependent variable: CURGPA

	Economics	Biology	Mathematics	Psychology
Constant	2.34*	2.36*	2.35*	2.26*
	(78.41)	(90.77)	(75.50)	(77.35)
WITHD	-0.27**	-0.57*	-0.46*	-0.25
	(-1.98)	(-4.21)	(-4.19)	(-1.12)
R^2	0.004	0.014	0.017	0.001

* significance at 1% level
**significance at 5% level

Table 9. Withdrawal Effect on Student Success, Spring 1991
(Regression Coefficient over T-ratio)

Method: OLS
Dependent variable: CURGPA

	Economics	Biology	Mathematics	Psychology
Constant	2.26*	2.24*	2.14*	2.20*
	(71.90)	(68.90)	(62.36)	(65.30)
WITHD	-0.18	-0.31**	-0.27**	-0.81*
	(-0.97)	(-1.97)	(-2.07)	(-2.92)
R^2	0.001	0.004	0.005	0.009

* significance at 1% level
**significance at 5% level

this result is that students who like to withdraw from courses tend to have lower grade point averages.

CHAPTER V

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Summary

The results of this study suggest that, in general, the models fit well in explaining the relationship between withdrawals and its expected determinants. Individually, however, most of the independent variables are not statistically significant for either Fall 1990 or Spring 1991 cohorts.

Students who attempted less credits are more likely to withdraw from any given course, which is contrary to what was predicted. On the other hand, with the exception in Economics and Biology of Fall 1990, students who enter a semester with high cumulative grade points are less likely to withdraw.

The effect of age on withdrawals is consistent with a priori expectations across the courses for both Fall 1990 and Spring 1991 semesters. The older the students, the less likely they are to withdraw. This effect is particularly significant for students in Economics, who have the highest average age. This result, however, contradicts the previous study by Adams and Becker (1990).

The current study also finds that the completion coefficient as measured by the ratio of the number of hours

completed to the number of hours attempted at the start of the semester, shows a negative relationship with withdrawals in most courses. Thus, students who have tended to persist in the past are less likely to withdraw from any given course in the current semester.

The number of hours completed prior to the semester tends to be positively correlated with withdrawals. Exceptions are Biology for the Fall of 1990 and Psychology for the Spring of 1991. However, this relationship is found statistically significant only in Mathematics. This unexpected result was also found by Adams and Becker (1990). Students with more experience in the sense of having completed more credit hours are more likely to withdraw.

Finally, this study reveals that students who are likely to withdraw from courses tend to have lower grade point average. With the exception of Psychology for the Fall of 1990 and Economics for the Spring of 1991, this tendency is statistically significant for all courses.

Conclusions

Overall the models are well replicated for both the Fall of 1990 and the Spring of 1991. Results indicate that course withdrawal behavior is a multidimensional construct in the sense that it is affected by different determinants. This study also reports several results that contradict those of previous studies (Adams and Becker 1990).

The major finding in this study is that older students are more likely to persist. It appears that older students are better prepared, and hence more effective, in the process of selecting courses.

Policy Implications

The results of this study suggest some recommendations for student advising, instructor, and withdrawal policies in general. First, in providing students with a better advising program, administrators should consider factors such as past withdrawal behavior of students, the number of hours completed, and age. Future withdrawals can be estimated from the past withdrawal behavior. Attention should be focused more on younger students. Students who have completed more credit hours still may need help in course selection.

Second, departments should reformulate the distribution of course loads for instructors with assistant professor rank such that it is proportional with other ranks. The faculty should realize that the quality of the course they teach is a major determinant of student course withdrawals.

Third, the policy for credit transfer could probably be relaxed to allow the student to transfer more credits. Students who have transfer credits tend persist in the course, and hence to graduate faster than those who withdraw.

Recommendations for Future Study

Based on the regression results, it is clear that this study has several weaknesses. Therefore, three recommendations are suggested for future research on student course withdrawal. First, the causal model of student course withdrawal should be tested also for other colleges or universities to get a more general interpretation of the determinants of course withdrawals.

Second, variables in the model may be added or deleted, but the basic variables of the model: student attributes, pre-semester background, and class attributes variables should be retained in the study of course withdrawals. For example, attitudinal variables may be added into the model.

Finally, it is also suggested to investigate the relationship between student major and course withdrawal for some of principle courses only function as service courses for other majors. In this study, Mathematics has the highest withdrawal rate, but it also has the smallest number of students who majoring in Mathematics.

APPENDICES

APPENDIX A

DEFINITION OF TERMS

DEFINITION OF TERMS

College Withdrawal. Student who leaves college before completing a degree program which may result from academic dismissal or voluntary withdrawal (Tinto 1982, 3).

Dropout. Often used interchangeable with withdrawal.

Persister. This is defined as nondropout.

Attrition. Often used interchangeable with withdrawal.

Free drop-add period. The period for which students are free to drop any number of courses without any type of penalty. This period is the first four weeks of the semester.

Course withdrawal. Withdrawal from course after the free drop-add period and up to the eighth week of the semester. The effect of this course withdrawal is the appearance of a permanent "W" grade on the student transcript.

Satisfaction. This is defined as "a state a person experiences when a performance or outcome has fulfilled his or her expectations" (Kotler and Fox 1985, 34). If the courses offered match expectations, the student is satisfied; if they fall short, he or she is dissatisfied.

APPENDIX B

LIST OF VARIABLES

LIST OF VARIABLES

AGE : The student's age.

ATHLT : Code 1 if the student receives athlete scholarship and 0 otherwise.

CLASIZ : The number of students in the course.

CUMHRS : Cumulative credits hours completed as of the start of the semester.

CUMATT : Cumulative credits HOURS attempted as the start of the semester.

CPLCOF : Coefficient of completion at the start of the semester as the ratio of CUMHRS to CUMATT.

CURCRD : Credits attempted in the semester, at the end of drop-add period.

CUMGPA : Cumulative grade point average as of the start of the semester.

CURGPA : Grade average point at the semester.

ETHN1 : Student ethnic origin; code 1 if Asian and 0 otherwise.

ETHN2 : Code 1 if Black and 0 otherwise.

ETHN3 : Code 1 if Hispanic and 0 otherwise.

EXPER1 : Instructor's experience. Code 1 if assistant professor and 0 otherwise.

EXPER2 : Code 1 if graduate student instructor, 0 otherwise.

FINAID : Code 1 if the student receives financial aid from the university and 0 otherwise.

INSGDR : Instructor's gender. Code 1 if female and 0 male

MEET1 : Course scheduling. Code 1 if offered between 1:00PM - 5.00PM and 0 otherwise.

MEET2 : Code 1 if offered between 6:00PM - 9:30PM and 0 otherwise.

OWEMO : Code 1 if the student owes money to the university, 0 otherwise.

STDGDR : Gender of student. Code 1 if male and 0 if female.

TRSCRD : Number of credits completed outside Middle Tennessee State University and transferred into the student's program.

WITHD : Withdrawal students. Code 1 if withdraw and 0 otherwise.

APPENDIX C

BINARY CHOICE MODELS

BINARY CHOICE MODELS

Introduction

Consider a student is facing a course withdrawal problem. The choice to be modelled is withdrawing from a course or not. This binary choice can be written as

choice 1: withdrawing from a course

choice 2: not withdrawing

Furthermore, suppose a sample of n students is observed and let the binary choice be represented by the dichotomous variable y such that

$$y_i = 1 \quad \text{if choice 1 is made by student i}$$
$$= 0 \quad \text{otherwise}$$

Let

$$v = (v_1, v_2, \ldots, v_t)$$

be a vector of characteristics associated with the two choices; finally, let

$$c_i = (c_1, c_2, \ldots, c_s)$$

be the vector describing the student and class characteristics.

In the usual general linear model (GLM) fashion, this phenomenon can be modelled as

$$y_i = \beta' \mathbf{x}_i + e_i, \qquad i = 1, 2, \ldots, n \tag{1}$$

where

$$\mathbf{x}_i = (v, c_i)$$

β' is a vector of unknown parameters and e_i is the unobservable error term.

The Problem of General Linear Model

An attempt to think of discrete variable problems in a general linear model context will bring some difficulties. First, the dependent variable y_i in Equation (1) can only take two values, while leaving the $\beta'\mathbf{x}_i$ part unbounded. Second, since y_i can only assume two values, then e_i can only assume two values; that is

$$e_i = 1 - \beta'\mathbf{x}_i \quad \text{if } y_i = 1$$
$$= -\beta'\mathbf{x}_i \quad \text{if } y_i = 0$$

Third, under the usual GLM assumption that

$$E[y_i] = \beta'\mathbf{x}_i$$

and given the Bernoulli character of the random variable y_i, it must be the case that

$$E[y_i] = \text{Prob}[y_i=1] = F(\mathbf{x}_i,\beta) = \beta'\mathbf{x}_i$$

is the probability of

$$e_i = 1 - \beta'\mathbf{x}_i,$$

and that

$$\text{Prob}[y_i=0] = 1 - F(\mathbf{x}_i,\beta) = 1 - \beta'\mathbf{x}_i$$

is the probability of

$$e_i = -\beta'\mathbf{x}_i$$

But given that $\beta'\mathbf{x}_i$ is unbounded, this model can give probabilities that lie outside the [0,1] interval. Fourth, with this probability structure, e_i is heteroscedastic since

$$\begin{aligned} \mathrm{Var}(e_i) &= \boldsymbol{\beta}'\mathbf{x}_i(1 - \boldsymbol{\beta}'\mathbf{x}_i) \\ &= E[y_i](1 - E[y_i]) \end{aligned}$$

Any effort to manage this with the generalized least squares techniques would only create a more serious flaw since there is no guarantee that the predictions from this model will truly look like probabilities (Greene 1989, 663).

Actually, the central issue in this case is what determines the probability that the *i*th student chooses in accordance with the choice 1, and hence Equation (1) should be considered as a facilitator for this purpose (Dhrymes 1986, 1571). Thus, by letting

$$p_{i1} = F(\mathbf{x}_i, \boldsymbol{\beta}) = \int_{-\infty}^{\boldsymbol{\beta}'\mathbf{x}_i} f(\theta)\,d\theta$$

$$p_{i2} = 1 - F(\mathbf{x}_2, \boldsymbol{\beta}) = \int_{\boldsymbol{\beta}'\mathbf{x}_i}^{\infty} f(\theta)\,d\theta$$

where $f(\cdot)$ is a suitable density function with known parameters, the dependence of the probabilities of choice on the observable characteristics of the student is formalized.

Probit and Logit Models

In this section the binary choice model will be formulated with specific reference to economic theory, especially to utility maximization theory. Hence the student is hypothesized to behave so as to maximize his/her utility in choosing between two actions; that is, to withdraw or not to withdraw. Let the utility function take

the form

$$u_i = u(v, c_i; \mu) + e_i, \quad i = 1, 2, \ldots, n \tag{2}$$

where

$$u(v, c_i; \mu) \equiv w(u|v, c_i), \quad e_i = u_i - u(v, c_i; \mu)$$

and μ is a vector of unknown parameters.

If student i selects choice 1, then his/her utility would become

$$u_{i1} = u(v, c_i; \mu_1) + e_{i1}$$

The reason the parameter vector μ is being subscripted is because v does not vary across choices. If the student selects choice 2, then

$$u_{i2} = u(v, c_i; \mu_2) + e_{i2}$$

Now the utilities u_{i1} and u_{i2} are random, and student i will select choice 1 only if

$$u_{i1} > u_{i2}$$

or if the unobservable random variable

$$y_i^* = u_{i1} - u_{i2} > 0$$

Consequently the values of the observable random variable y_i are determined as

$$y_i = 1 \quad \text{if} \quad y_i^* > 0$$
$$= 0 \quad \text{if} \quad y_i^* \leq 0$$

Let y_i^* be written as

$$y_i^* = u(v, c_i; \mu_1) - u(v, c_i; \mu_2) + (e_{i1} - e_{i2})$$
$$= \beta' x_i + e_i^*$$

where β', x_i, and e_i^* are unknown parameters, regressors, and random errors in the linear statistical model for y_i^*;

hence it is assumed that the function $u(\cdot)$ in Equation (2) is linear. The probability p_i that $y_i = 1$ is

$$\text{Prob}[y_i=1] = \text{Prob}[y_i^*>0] = \text{Prob}[e_i^*>-\beta' \mathbf{x}_i] \tag{3}$$

To make the model workable, a particular distribution for e_i^* must be specified. The two most common distributions are the standard normal and the logistic. The normal distribution has been used in many analyses, giving rise to the probit model

$$\text{Prob}[y_i=1] = \int_{-\infty}^{\beta' \mathbf{x}_i} \tau(t)dt$$

$$= \Phi(\beta' \mathbf{x}_i) \tag{4}$$

The logit model which is based on the logistic cumulative distribution function is specified as

$$\text{Prob}[y_i=1] = \frac{e^{\beta' \mathbf{x}_i}}{1 + e^{\beta' \mathbf{x}_i}}$$

$$= \Omega(\beta' \mathbf{x}_i) \tag{5}$$

Using the properties mentioned above, the probability model can be written as

$$E[y_i] = 1[F(\beta' \mathbf{x}_i)] + 0[1-F(\beta' \mathbf{x}_i)]$$

$$= F(\beta' \mathbf{x}_i)$$

with the partial derivative

$$\partial E[y_i]/\partial \mathbf{x}_i = f(\beta' \mathbf{x}_i)\beta \tag{6}$$

where $f(\cdot)$ is the density function that corresponds to the cummulative distribution, $F(\cdot)$.

Estimation of the Models

The parameter estimates of the binary choice model will be based on the method of maximum likelihood. Given a sample of n independent observations (one observation per student), the likelihood function is

$$L^* = \Pi_i f(y_i) = \Pi_i p_i^{y_i} (1-p_i)^{(1-y_i)}$$

$$= \Pi_i [F(\beta' x_i)]^{y_i} [1-F(\beta' x_i)]^{(1-y_i)} \quad (7)$$

where $F(\cdot)$ is either the standard normal or logistic cumulative density function (cdf), and where

$$y_i = 1 \quad \text{if choice 1 is made}$$

$$= 0 \quad \text{otherwise}$$

As usual, Equation (7) is transformed to its logarithm form

$$L = \Sigma_i [y_i \ln F(\beta' x_i) + (1-y_i) \ln (1-F(\beta' x_i))] \quad (8)$$

The first- and second-order derivatives with respect to β are

$$\frac{\partial L}{\partial \beta} = \Sigma_i [\frac{y_i f}{F} - (1-y_i)\frac{f}{1-F}] x_i \quad (9)$$

$$\frac{\partial^2 L}{\partial \beta \partial \beta'} = \Sigma_i [y_i \frac{F x_i' (\partial f/\partial \beta) - f^2 x_i' x_i}{F^2}$$

$$- (1-y_i)\frac{(1-F) x_i' (\partial f/\partial \beta') + f^2 x_i' x_i}{(1-F)^2}] \quad (10)$$

where F and f are values of the relevant cdf and the corresponding density function at $\beta' x_i$. It should be noted that Equation (9) is highly nonlinear and requires an iterative solution. Whether the estimator so obtained is

the maximum likelihood or not will depend on whether the sign of Equation (10) is negative definite.

The first-order conditions for probit and logit models are relatively straightforward to analyze. For the logit model, by manipulating Equations (5), (6), and (9), it can be shown that

$$\frac{\delta L}{\delta \beta} = \prod_i (y_i - \Omega) x_i$$

For the probit model, the log likelihood is

$$L = \sum_{y=0} \ln(1-\Phi) + \sum_{y=1} \ln\Phi \qquad (11)$$

The first-order conditions for Equation (11) are

$$\frac{\delta L}{\delta \beta} = \prod_{y=0} \frac{-\tau}{1-\Phi} x_i + \prod_{y=1} \frac{\tau}{\Phi} x_i$$

To estimate the parameters of probit and logit models, an iterative procedure called the Newton method will be applied. In this iterative procedure, the (i+1)st round estimate, say $\hat{\beta}_{i+1}$, is given by

$$\hat{\beta}_{i+1} = \hat{\beta}_i - \left[\frac{\partial^2 L}{\partial \beta \partial \beta'}\Big|_{\hat{\beta}_i}\right]^{-1} \left[\frac{\partial L}{\partial \beta}\Big|_{\hat{\beta}_i}\right]$$

where $[\partial^2 L/\partial\beta\partial\beta' | \hat{\beta}_i]$ is the matrix of second partials of the log likelihood function evaluated at the ith round estimate $\hat{\beta}_i$. Under the condition given in Equation (8), a global maximum solution will be guaranteed for any set of starting values $\hat{\beta}_0$. Finally, a consistent estimate of the asymptotic covariance matrix to be used as a basis for

hypothesis tests is given by

$$-\left[\frac{\partial^2 L}{\partial \beta \partial \beta'}\right]^{-1}$$

which is evaluated at the last set of parameter estimates $\tilde{\beta}$.

Model Validation

When the dependent variable is a binary variable, the use of traditional R^2 for model validation is not appropriate (Maddala 1983). Instead, two alternative measures of R^2 will be used in this study: pseudo R^2 and count R^2 (Maddala 1988, 279).

The pseudo R^2 is based on likelihood ratios and it is defined as

$$\text{pseudo } R^2 = \frac{L_{UR}^{2/n} - L_R^{2/n}}{1 - L_R^{2/n}}$$

where L_{UR} is the maximum of the likehood function when maximized with respect to all parameters and L_R is the maximum when mazimized with the restriction $\beta=0$.

To measure the predictive power of the model, count R^2 is used. This is expressed as

$$\text{count } R^2 = \frac{\text{number of correct predictions}}{\text{total number of observations}}$$

APPENDIX D

ADDITIONAL REGRESSION TABLES

Table A1. Regression Results for Biology, Fall 1990
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	0.66	9.38	12.16
	(8.15)	(4.64)	(4.49)
ETHN1	0.05	-8.12	-15.07
	(0.27)	(-0.01)	(-0.01)
ETHN2	0.24	0.76	1.05
	(3.73)	(2.15)	(2.40)
ETHN3	-0.15	-5.84	-13.80
	(-0.65)	(-0.01)	(-0.01)
STDGDR	0.06	0.23	0.35
	(1.42)	(0.83)	(0.96)
AGE	-0.00	-0.01	-0.02
	(-0.42)	(-0.31)	(-0.37)
ATHLT	-0.05	0.02	-0.07
	(-1.14)	(0.07)	(-0.16)
OWEMO	0.01	-0.01	-0.05
	(0.13)	(-0.03)	(-0.14)
FINAID	0.10	0.60	0.88
	(1.76)	(1.70)	(1.92)
CUMHRS	0.00	-0.01	-0.01
	(-0.16)	(-0.85)	(-0.92)
CPLCOF	0.03	0.47	0.49
	(0.25)	(0.62)	(0.50)
TRSCRD	0.01	0.05	0.07
	(1.25)	(0.77)	(1.09)
CUMGPA	0.05	-0.01	0.03
	(1.88)	(-0.07)	(0.13)
CURCRD	-0.10	-0.49	-0.60
	(-12.05)	(-8.50)	(-8.06)
MEET1	-0.05	-0.68	-1.23
	(-0.85)	(-1.53)	(-1.93)
MEET2	-0.35	-2.72	-3.73
	(-4.11)	(-3.95)	(-3.90)
CLASIZ	-0.04	-0.23	-0.30
	(-4.48)	(-4.17)	(-3.98)
EXPER1	0.06	0.45	0.54
	(1.47)	(1.62)	(1.47)
INSGDR	-0.01	-0.22	-0.28
	(-0.15)	(-0.61)	(-0.60)
Log-Likelihood.....		-128.30	-129.93
Restricted (Slopes=0) Log-L.		-201.36	-201.36
Chi-Squared (17).....		146.13	
Significance Level.....		0.321173E-13	

Table A2. Regression Results for Mathematics, Fall 1990
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	0.10	1.57	1.89
	(4.59)	(1.21)	(1.21)
ETHN1	-0.04	0.10	-0.01
	(-0.08)	(0.12)	(-0.01)
ETHN2	-0.20	-0.59	-0.72
	(-1.67)	(-1.45)	(-1.40)
ETHN3	-0.68	-7.15	-14.53
	(-1.44)	(-0.01)	(-0.01)
STDGDR	-0.01	0.02	0.04
	(-0.10)	(0.08)	(0.16)
AGE	-0.01	-0.02	-0.03
	(-1.00)	(-0.75)	(-0.88)
ATHLT	-0.08	-0.24	-0.40
	(-0.93)	(-0.88)	(-1.19)
OWEMO	-0.04	-0.22	-0.18
	(-0.52)	(-0.96)	(-0.67)
FINAID	0.01	-0.26	-0.24
	(0.11)	(-0.74)	(-0.58)
CUMHRS	0.00	0.02	0.02
	(2.96)	(3.09)	(3.11)
CPLCOF	-0.32	-0.93	-1.13
	(-1.77)	(-1.49)	(-1.52)
TRSCRD	-0.01	-0.03	-0.03
	(-0.35)	(-0.59)	(-0.50)
CUMGPA	-0.12	-0.45	-0.51
	(-2.50)	(-3.22)	(-3.04)
CURCRD	-0.12	-0.24	-0.27
	(-8.32)	(-7.22)	(-6.97)
MEET1	-0.04	-0.02	0.00
	(-0.31)	(-0.08)	(0.02)
CLASIZ	0.00	0.02	0.03
	(0.39)	(0.79)	(0.78)
EXPER1	0.16	0.51	0.58
	(1.80)	(1.83)	(1.74)
EXPER2	-0.04	-0.14	-0.23
	(-0.57)	(-0.50)	(-0.65)
Log-Likelihood.....		-235.86	-239.27
Restricted (Slopes=0) Log-L.		-290.60	-290.60
Chi-Squared (16).....		109.48	
Significance Level.....		0.32173E-13	

Table A3. Regression Results for Psychology, Fall 1990
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	-0.99	6.82	8.91
	(6.67)	(2.78)	(2.89)
ETHN1	0.20	1.66	2.71
	(1.61)	(1.46)	(1.95)
ETHN2	0.00	0.11	0.37
	(-0.05)	(0.20)	(0.51)
ETHN3	0.28	1.25	1.87
	(1.64)	(1.22)	(1.59)
STDGDR	0.02	0.13	0.13
	(0.61)	(0.35)	(0.24)
AGE	-0.01	-0.21	-0.24
	(-3.14)	(-2.49)	(-2.37)
ATHLT	0.04	0.08	0.08
	(0.59)	(0.17)	(0.12)
OWEMO	0.02	0.54	0.78
	(0.60)	(1.30)	(1.36)
FINAID	-0.02	-0.11	-0.29
	(-0.46)	(-0.19)	(-0.34)
CUMHRS	0.00	0.02	0.02
	(0.98)	(1.11)	(1.09)
CPLCOF	-0.12	-2.11	-2.91
	(-1.78)	(-1.94)	(-1.89)
TRSCRD	0.00	-0.03	-0.06
	(-0.15)	(-0.31)	(-0.32)
CUMGPA	0.01	0.05	-0.05
	(0.79)	(0.21)	(-0.15)
CURCRD	-0.05	-0.45	-0.60
	(-7.80)	(-5.86)	(-6.00)
MEET1	-0.05	-0.30	-0.80
	(-0.65)	(-0.45)	(-0.83)
MEET2	-0.32	-9.63	-18.57
	(-3.20)	(-0.02)	(-0.01)
CLASIZ	0.00	-0.01	-0.01
	(-0.93)	(-1.47)	(-1.28)
EXPER1	0.12	0.67	1.02
	(2.15)	(1.12)	(1.29)
INSGDR	0.00	0.16	0.27
	(0.09)	(0.31)	(0.37)
Log-Likelihood.....		-65.383	-65.52
Restricted (Slopes=0) Log-L.		-100.74	-100.74
Chi-Squared (16).....		70.710	
Significance Level.....		0.11481E-08	

Table A4. Regression Results for Economics, Spring 1991
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	-0.90	6.85	10.10
	(5.30)	(2.83)	(3.08)
ETHN1	0.12	0.85	1.34
	(0.84)	(0.95)	(1.22)
ETHN2	-0.12	-1.47	-1.83
	(-1.69)	(-1.82)	(-1.70)
ETHN3	-0.16	-5.74	-13.68
	(-0.65)	(-0.01)	(-0.01)
STDGDR	-0.04	-0.19	-0.24
	(-0.84)	(-0.63)	(-0.59)
AGE	-0.02	-0.30	-0.44
	(-3.26)	(-3.14)	(-3.15)
ATHLT	0.08	0.58	0.81
	(1.59)	(1.75)	(1.83)
OWEMO	-0.01	-0.08	-0.19
	(-0.24)	(-0.25)	(-0.43)
CUMHRS	0.00	0.02	0.01
	(1.07)	(1.33)	(1.33)
CPLCOF	-0.04	-0.03	0.04
	(-0.24)	(-0.04)	(0.03)
TRSCRD	0.00	-0.16	-0.22
	(-1.94)	(-1.14)	(-1.10)
CUMGPA	-0.01	-0.11	-0.13
	(-0.38)	(-0.53)	(-0.46)
CURCRD	-0.04	-0.24	-0.31
	(-4.70)	(-4.81)	(-5.02)
MEET1	-0.05	-0.35	-0.54
	(-0.97)	(-0.78)	(-0.87)
MEET2	-0.04	0.24	0.33
	(-0.31)	(0.37)	(0.47)
CLASIZ	0.00	0.00	-0.01
	(-0.99)	(-0.60)	(-0.74)
EXPER1	-0.05	-0.34	-0.49
	(-0.96)	(-0.91)	(-0.96)
EXPER2	-0.01	-0.18	-0.23
	(-0.23)	(-0.43)	(-0.40)
Log-Likelihood.....		-105.13	-105.31
Restricted (Slopes=0) Log-L.		-128.72	-128.72
Chi-Squared (17).....		47.197	
Significance Level.....		0.11380E-03	

Table A5. Regression Results for Biology, Spring 1991
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	0.60	7.94	10.23
	(3.86)	(2.16)	(2.23)
ETHN1	0.12	0.94	0.94
	(0.73)	(1.07)	(0.83)
ETHN2	0.00	0.00	-0.07
	(0.18)	(-0.01)	(-0.11)
ETHN3	0.40	0.85	1.12
	(1.27)	(0.71)	(0.88)
STDGDR	0.08	0.70	0.85
	(1.81)	(2.24)	(2.14)
AGE	-0.01	-0.06	-0.10
	(-1.57)	(-1.45)	(-1.60)
ATHLT	-0.01	-0.05	-0.01
	(-0.19)	(-0.15)	(-0.02)
OWEMO	-0.01	-0.30	-0.53
	(-0.10)	(-0.93)	(-1.21)
CUMHRS	0.00	1.07	0.01
	(2.07)	(1.54)	(1.33)
CPLCOF	-0.28	-1.31	-1.61
	(-2.27)	(-1.72)	(-1.66)
TRSCRD	0.00	-0.03	-0.04
	(-1.74)	(-1.64)	(-1.52)
CUMGPA	-0.04	-0.19	-0.25
	(-0.83)	(-0.93)	(-0.99)
CURCRD	-0.08	-0.42	-0.51
	(-9.44)	(-7.28)	(-7.07)
MEET1	0.04	0.13	0.22
	(0.46)	(0.36)	(0.48)
MEET2	0.04	0.10	0.09
	(0.25)	(0.18)	(0.13)
CLASIZ	-0.04	-0.16	-0.19
	(-1.34)	(-1.11)	(-1.05)
EXPER1	-0.08	-0.45	-0.54
	(-1.26)	(-1.32)	(-1.26)
INSGDR	0.16	1.10	1.35
	(2.85)	(3.02)	(2.88)
Log-Likelihood.....		-116.51	-118.10
Restricted (Slopes=0) Log-L.		-170.56	-170.56
Chi-Squared (17).....		108.11	
Significance Level.....		0.32173E-13	

Table A6. Regression Results for Mathematics, Spring 1991
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	1.43	8.50	10.22
	(7.56)	(4.63)	(4.68)
ETHN1	0.16	0.53	0.73
	(0.56)	(0.55)	(0.65)
ETHN2	0.16	0.37	0.40
	(1.55)	(1.11)	(1.01)
ETHN3	0.04	-5.07	-12.01
	(0.12)	(-0.01)	(-0.01)
STDGDR	0.01	0.18	0.16
	(0.24)	(0.73)	(0.54)
AGE	-0.04	-0.13	-0.14
	(-3.11)	(-2.69)	(-2.54)
ATHLT	0.04	0.26	0.32
	(0.66)	(0.99)	(1.02)
OWEMO	0.04	0.18	0.24
	(0.63)	(0.71)	(0.78)
CUMHRS	0.01	0.03	0.03
	(5.37)	(4.75)	(4.65)
CPLCOF	-0.80	-3.02	-3.63
	(-4.50)	(-3.96)	(-3.81)
TRSCRD	0.00	0.00	0.00
	(0.01)	(0.53)	(0.27)
CUMGPA	0.00	-0.02	-0.04
	(0.04)	(-0.10)	(-0.21)
CURCRD	-0.08	-0.27	-0.30
	(-7.23)	(-6.23)	(-5.85)
MEET1	0.01	-0.05	-0.17
	(0.13)	(-0.20)	(-0.49)
CLASIZ	-0.04	-0.13	-0.16
	(-3.47)	(-3.28)	(-3.39)
EXPER1	0.24	0.61	0.86
	(1.40)	(1.20)	(1.42)
EXPER2	0.16	0.40	0.64
	(0.93)	(0.78)	(1.03)
Log-Likelihood.....		-179.70	-182.82
Restricted (Slopes=0) Log-L.		-230.06	-230.06
Chi-Squared (16).....		100.73	
Significance Level.....		0.32173E-13	

Table A7. Regression Results for Psychology, Spring 1991
(Regression Coefficient over Asymptotic T-ratio)

Variable	OLS	Probit	Logit
Constant	-1.42	0.34	0.92
	(3.74)	(0.17)	(0.33)
ETHN1	-0.10	-5.38	-13.90
	(-0.09)	(-0.01)	(0.00)
ETHN2	0.08	0.64	0.80
	(1.50)	(1.14)	(1.04)
ETHN3	-0.04	-5.49	-14.11
	(-0.31)	(0.00)	(0.00)
STDGDR	0.00	0.16	0.21
	(0.01)	(0.35)	(0.33)
AGE	0.00	0.00	-0.01
	(-0.44)	(0.03)	(-0.08)
ATHLT	0.04	0.34	0.54
	(0.61)	(0.65)	(0.77)
OWEMO	0.12	1.22	1.54
	(2.98)	(2.52)	(2.29)
CUMHRS	0.00	-0.01	-0.01
	(-0.39)	(-0.51)	(-0.61)
CPLCOF	0.05	1.25	1.66
	(0.68)	(1.05)	(1.03)
TRSCRD	0.00	0.00	0.00
	(0.02)	(-0.08)	(0.00)
CUMGPA	-0.01	-0.32	-0.45
	(-0.34)	(-1.04)	(-1.10)
CURCRD	-0.04	-0.37	-0.48
	(-6.94)	(-4.99)	(-5.10)
MEET1	-0.05	-0.80	-1.21
	(-0.85)	(-0.86)	(-0.94)
MEET2	-0.20	-7.52	-16.54
	(-1.78)	(-0.01)	(-0.01)
CLASIZ	0.00	0.00	0.00
	(0.26)	(-0.35)	(-0.27)
EXPER1	0.00	-0.03	0.10
	(-0.02)	(-0.03)	(0.07)
INSGDR	0.00	-0.26	-0.09
	(0.05)	(-0.39)	(-0.10)
Log-Likelihood.....		-47.48	-47.97
Restricted (Slopes=0) Log-L.		-72.85	-72.85
Chi-Squared (17).....		50.75	
Significance Level.....		0.32336E-04	

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