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Models of completion time for the baccalaureate degree

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MODELS OF COMPLETION TIME FOR THE BACCALAUREATE DEGREE

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MODELS OF COMPLETION TIME FOR THE BACCALAUREATE DEGREE

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ABSTRACT

MODELS OF COMPLETION TIME FOR THE BACCALAUREATE DEGREE

By Xiancheng Lu

The purpose of this study is to analyze the factors that determine the delay of graduation. The author builds models to assess the impact of multiple relevant factors on degree completion time. The identification of these variables should assist university administrators and faculty to revise recruitment, assessment, and placement policies and practices.

This study selected a sample of the students who graduated in Fall 1991, Spring 1992, and Summer 1992 at Middle Tennessee State University. The explanatory variables can be categorized into three groups: demographic factors, pre-college factors, and college relevant factors. Ordinary least squares (OLS), Lognormal, and Poisson regressions are employed to describe associations between independent and dependent variables. Monte Carlo tests are then used to evaluate the models. Treatment effects are measured for a number of variables in order to correct for selection bias. Marginal effect, standardized coefficient, and elasticity techniques are used to assess the variables.

The results of this study indicate that degree completion time is primarily attributable to the college

relevant variables. These factors include failure in and withdrawal from some courses, recovery from stopout, graduate grade point average, taking extra credit through personal interest, lack of financial aid, studying for minors, changing majors, and attending summer school.

Other results suggest that the degree completion time is not related to ethnic background, age, gender, hometown location, degree type, military service, and early declaration of a major.

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CHAPTER I

INTRODUCTION

Colleges and universities have been concerned with the retention of their students for numerous years. The literature of the 1970s and 1980s is replete with research related to the marketing of institutions to attract students (Beal and Noel 1980; Kemerer, Baldridge, and Green 1982). There was a tendency to assume that college achievement is related to persistence of students.

Along with the interest in retention, another phenomenon is becoming very significant. Students now are taking more and more years to complete their baccalaureate degree. Can we contentedly focus on the declining dropout rate while students persist at college longer and longer to get their degree?

The traditional view of post secondary education was that students would enter college in the fall immediately after high school graduation, persist full time for 4 years, and graduate in the spring of the fourth year. Obviously, the old concepts no longer fit the practices of today's students. G. B. Vaughan and Associates has pointed out: "Just as programs designed in the 1940s and before had to be reviewed, revised and renewed to meet the needs of the 1960s, so too, programs designed in the 1960s will have to be recast to meet the needs of the 1980s" (1983, 247).

However, it was not until the early 1980s that delay of graduation began to be recognized as a significant phenomenon in post secondary education (Frances 1980). In order to understand persistence and progress through post secondary education, it is necessary to consider both the positive and negative aspects of delayed graduation.

Purpose of This Study

The purpose of this study is to analyze the factors that determine the delay of graduation. This study aims to extend the research of early studies. Through this study the author wants to assess the impact of all relevant variables on degree completion time with particular applicability to the students at Middle Tennessee State University (MTSU).

Specifically, first, this study is designed to find an answer to the following question: Is it possible to explain effectively the completion time for bachelor's degree within a multivariate context? What kinds of graduate characteristics are associated with the completion time for the bachelor's degree and how do these variables operate and interact in the degree completion time frame? Can we predict the graduate completion time by using pre-college and demographic information?

Second, by determining the factors affecting the time taken to complete the bachelor's degree, the author hopes that this study can provide empirical data and models to the administrators in this university (or other large suburban public universities) and help them to revise recruitment, assessment, and placement policies and practices.

Third, identification of variables which affect degree completion time also can help professors in their reviewing of course content and teaching methodologies.

Fourth, as a new issue in post-secondary education, the author hopes this study can provide background data for future, more definitive studies of explaining and predicting degree completion time in post-secondary education.

Building on previous research, there are two major contributions in this study. First, the author built the regression models by applying the econometrics techniques according to the statistical distribution and characteristics of the dependent variable, the degree completion time. By using multivariate regression analysis, this study can measure the strength of association among the characteristics of graduates and the degree completion time. In this study the author employed ordinary least squares (OLS), Lognormal, and Poisson models, as well as Monte Carlo tests and treatment effect analysis.

Second, the author collected data to represent the salient characteristics of students which relate to the degree completion time from the MTSU Students Information System (SIS).

Limitations of the Study

This study is limited by the following factors.

First, the results, which were drawn from a large public and suburban university, may be applied to other similar institutions. However, the conclusion may not be representative for the United States as a whole.

Second, this study is based on the records of students who graduated at MTSU in Fall 1991, Spring 1992, and Summer 1992. Better results are usually found if we use a longitudinal data set.

Third, the record system in MTSU's SIS system has been expanded to include more variables since 1989. Some previous records, especially those of transfer students, have missing values. This study will exclude the graduates who were transfer students due to unreliable records.

Fourth, as with other models in the social sciences, this study has a problem of misspecification. Human beings are hard to represent by pure numbers. A lot of information such as motivational factors, personal characteristics, family education, and family relationships, which may be important to this study, is hard to measure and include in the research.

Organization of the Study

This study is organized into five chapters. Chapter II includes a review of literature related to the issue of degree completion time. Due to the close relationship between the issue of degree completion time and the research on retention and attrition, retention and attrition is discussed at length to provide a comparison.

In Chapter III, research methodology will be described. This involves a description of the basic model employed in this study, a description of the population and sample, and an univariate analysis of the data used in this study. The statistical methods discussed are the Poisson and Lognormal regression and treatment analyses.

Chapter IV presents findings based on the results of this study. A comparison of out-of-sample prediction is made among the OLS, the Poisson, and Lognormal approaches by using Monte Carlo tests. In addition, this study also tests the early stage prediction model which uses the demographic, pre-college, and early college relevant information.

Chapter V presents a general summary, conclusions and suggestions for future research.

CHAPTER II

REVIEW OF RELATED LITERATURE

There has not been much research done in the field of degree completion time, possibly for two reasons. First, this phenomenon has only been recognized recently. Second, it is costly to collect the necessary student records', especially for the longitudinal studies.

From the nature of this issue, our literature survey should start from the studies on college retention and attrition. In a more general sense, degree completion time study can be seen as the extension of research on retention and attrition. Theoretically, a student who takes infinite (or a very long) time to complete his or her degree can be treated as an attrition student.

Identical with the retention and attrition research, we can categorize students into two groups, on-time graduation and delayed graduation. The reasons that are listed as the determinants of attrition can be similar to the factors that delay graduation. Since completion time is a relatively new topic of research, the author wishes to draw on experience by going over some relevant findings from retention and attrition studies.

Section 1: Retention and Attrition Research

Interest in the subject of retention and attrition has been expressed for more than 40 years (Munro 1981). This problem has become increasingly important as educational institutions experience the impact of declining enrollments and reduced budgets. The student's withdrawal is usually costly to both the student and the institution.

In 1987, a survey of member institutions of the American Association of State Colleges and Universities (AASCU) concerning student retention and attrition found that all 183 responding institutions had implemented programs or have been engaged in activities during the 1980's aimed at increasing retention (Cowart 1987).

National rates of attrition did not change significantly in the four decades spanning 1913-1953, according to a summary of retention and attrition studies by J. Summerskill (1962). T. J. Pantages and C. F. Creedon's study of college attrition from 1950 to 1975 cited the 1974 Statistical Abstracts of the United States that, "of the estimated 7.6 million undergraduate students enrolled in the United States in 1971, roughly 2.3 million will drop out of higher education completely" (Pantages and Creedon 1978, 49). Alexander W. Astin's longitudinal and multi-institutional study revealed an 81 percent drop-out rate in two-year colleges (Astin 1975).

On the other hand, Bruce Eckland conducted a 10-year follow-up study of all those students who dropped out during a four-year sequence to graduation (1964). Findings from this study suggest that of those students who dropped out for any length of time, 70 percent of them re-enrolled and approximately 55 percent graduated. Overall, of all the students who enroll in college, over 70 to 74 percent will eventually graduate. F. B. Jex and R. M. Merrill (1962), C. B. Johansson and J. E. Rossman (1973), and J. Trent and J. Ruyle (1965) also found similar results: 70-80 percent of students who drop out will re-enroll and 60-70 percent will graduate.

Although the literature on retention and attrition is vast, the research on this problem still can draw few definite conclusions. To say that the problem of attrition or retention is complex is an understatement. V. Tinto has suggested this is because "...it involves not only a variety of perspectives but also a range of different types of dropout behavior." (1982). A theory that could capture every facet of the withdrawal process would contain so many factors that it would become unmanageable.

Before the 1970's, most of the research on retention and attrition focused more on description rather than on explaining determinants. Sometimes one or two determinants were studied, when it was actually more reasonable to assume that multiple factors operated concurrently to produce attrition.

In 1972, Astin tried a stepwise regression model to identify the contribution of the relevant variables in explaining the variance in retention and attrition. The results show that the accurate prediction of whether a student will drop out cannot be made (Astin 1972, 33). J. E. Merritt (1974) also used stepwise regression to study biographical characteristics and academic achievement variables to determine which would reveal differences between community college students who entered and completed their programs of study and those who did not persist through to the degree.

A basic premise in explaining the process of attrition in most research is the prediction model of dropout by Tinto (1975). Tinto divided the factors studied into three basic categories: "(1) characteristics of individuals related to persistence in college (2) characteristics associated with an individual's interaction within the college setting and (3) characteristics of institutions of higher education associated with dropouts from college" (Tinto 1975, 99). Tinto points out that "despite the very large volume of recent studies on dropout, there have been few multivariate analyses that permit the reviewer to isolate the independent effects of various factors on dropout".

In their review of studies of college attrition from 1950 to 1975, Pantages and Creedon categorized the variables studied into: (1) demographic factors; (2) academic factors; (3)motivational factors and personality factors.

Following Tinto, there are many replicated studies in which specific factors were grouped using different samples or models (Newlon and Gaither 1980; Terezini, Lnrang, and Pascarella 1981; Naylor and Sanford 1982; Bean and Metzner 1985).

Other factors reviewed in the retention and attrition studies were the college environment, financial factors, and health factors. The author will discuss these factors in detail in the latter part of this chapter.

Section 2: Degree Completion Time Research

1. The Completion Time to Degree:

In 1987, a study conducted by the National Center for Education Statistics reported that 40 percent of all undergraduate students were age 24 or older, and about 23 percent were 30 or older (Korb, et al. 1988).

The report from the American Council on Education also confirmed that 40 percent of students enrolled in two- and four-year institutions are nontraditional students (MTSU Sidelines April 5, 1993).

In fact, the number of students in post-secondary education over age 30 increased by 37 percent in the 1977-78 through 1987-88 period, and is expected to increase by another 15 percent in the next ten year period. During that same period the number of college students in the 18-24 year range is expected to drop by 8 percent (U.S. Department of Education 1988).

Implied in the increment of non-traditional students, the degree completion time is getting longer and longer. However, universities vary widely in their four-year graduation rates from 75 percent at the University of Virginia and 55 percent at the University of Michigan to about 30 percent at the University of California.

Susan Hill has found that less than half of the students graduated within 4 years by using the data from the National Longitudinal Study of the High School Class of 1972 (1986). Analogous results were found by D. E. Lavin (1984) and R. T. Campbell (1980).

The on-time graduation rates of students at the City University of New York were studied. It was found that in the senior colleges 34 percent of regularly admitted students graduated after 4 years. Among open admission students only 16 percent earned diplomas after 4 years (Lavin 1984).

Katrin Spinetta's study found that the mean completion time to degree for graduates had increased from 7.61 terms in 1980 to 9.13 terms in 1990 in Peralta Community College System (Spinetta 1991).

Jane Grosset compared the graduates in 1982 with those in 1990 at Community College of Philadelphia. The results indicated that the years to graduation had increased over time, while nearly half (48.5%) of the 1982 graduates completed their degree requirements in three years or less, 30.1% of the 1990 cohorts did so in this time frame (1991).

"There are significant numbers of small liberal arts institutions that take in students mostly out of high school and graduate in four years. But their numbers have not grown," MTSU Sidelines cited the words of David Merkowitz, spokesman of the American Council on Education. "The growth (in enrollment) is in state colleges." (April 5, 1993), which are trending toward delayed graduation.

H. L. Hodgkinson has pointed out: "Studies done over the last 20 years affirm that for every 100 students admitted to a four-year bachelor's program, less than 50 would graduate from the same institution on time. If that time was extended to seven years, about 70 of the original 100 would graduate from the same, or another institution." (1985, 17).

2. The Degree Completion Time Debate

In order to understand persistence and progress through post secondary education, it is necessary to consider both the positive and negative aspects of the delayed graduation. Vaughan believes the growth of non-traditional students and the degree completion time has contributed for the most part to the open access movement (1984).

Many former high school graduates, who initially had the problems of financing education expenses, family responsibility, or test scores, could not enter post secondary education immediately after high school. Benefiting from the open access policy of universities, they had the chance to enter the university after a few years delay. They also could enroll in school as part-time students and finance the education expense from a part-time or full-time job. John Duff, president of Columbia College in Chicago thinks it is not a bad thing if students delay their graduation just due to working (MTSU Sidelines April 5, 1993).

Some students enter college to improve their knowledge in a particular content area, to gain additional ability, or refine job skills. Thus they may go to college as non-traditional students or stop out for a period to get social and working experience and then return back to school.

Some students take extra credits above the degree requirements to get useful knowledge. All of the above phenomena, which conspicuously delay graduation, represent the constructive influence of higher education.

Another group of nontraditional students expose the gloomy aspect of delayed graduation. W. Deegan described open access to "mean opportunity for achievement and also for failure, since students were accepted for programs and courses for which they were not academically qualified" (1985, 19). This is because the college just makes "efforts to seek, recruit, enroll, and retain every possible student in the community" (Rouche, Baker, and Brownell 1971, 11). Some students take fewer credits each semester, change their major frequently, take more entertainment courses, stop out for a rest, or work to earn money for beer and entertainment

"Given what a student is paying for college, why should an undergraduate degree take more than four years? They should be able to do it in four years." Owen Sammelson, vice president for administration at Gustavus Adolphus College in St. Peter, Minnesota, said students should not forget the loss of income if they take extra years to graduate (MTSU Sidelines April 5, 1993).

All of the above phenomena are bothering university administrators. For the students, the job market will change a lot even in one year. In the macro sense the country is wasting its capital and human resource since the university spends extra time for programs which can be finished in four years.

3. Review of the Degree Completion Time Literature

Bachelor's degree completion time studies now resemble the early stage of studies on retention and attrition. They are interested in describing the phenomena rather than invoking models to analyze the factors related to the degree completion time and developing explanatory and predictive models.

Single institution reports are conducted by many universities. They divide the students into several subgroups by demographic, academic or other criteria, then calculate the year of graduation and percentages for each group, and compare percentages across these groups.

In 1982, John D. Dennison conducted a study at the University of British Columbia and the University of Victoria to assess the academic performance of community college and technical institute transfer students. The time taken to complete the degree is an important measurement in this study.

A. B. Crawford used the Student Information System database in the University of Nebraska University at Omaha to examine length of time required to complete bachelor's degree for the graduates in 1986. Crawford lists the detail percentages in cross-tabulation analyses between several time frame measurements and some demographic factors (1989).

William E. Knight provides comparison of the degree completion time of the graduates of Kent State University in May, 1990 to the students' major, semester hours accumulated, gender, ethnicity, age, and grade point average (1990).

Using data from transcript records of the spring 1989 graduates in Los Angeles Community College District, containing enrollment dates and demographic information including gender, age, and ethnicity, Paul H. Dillon conducted a study of the length of time to complete the associates' degree. The statistical analyses focus on present variation of the median values among the various subgroups (1990).

Illinois Community College Board reports the time frame of their graduates in fall 1980 (1990). Shirley M. Gregory compares the difference in degree completion time between the co-op students and the control group students in 1990.

There is some degree completion time research using national data sets. As part of the National Longitudinal Study (NLS) of the High School Class of 1972, Eckland collected the information from the base year and the first three follow-up surveys of the NLS. Simple statistical tables concerned with the four-year graduation rate were initially reported (1981).

Hill and Owings compared the characteristics of graduates who completed bachelor's degrees within 4 years of high school graduation with graduates who took longer than 4 years. Data were obtained from the Post Secondary School Transcripts Study, a supplement to the NLS of the High School Class of 1972. The effects of the following characteristics on degree completion were assessed in percent: aptitude test composite score, high school curriculum (academic general, vocational), socioeconomic status, and region of high school (Northeast, North Central, South, West). The percent of degree recipients who completed a degree within 4 years was also calculated for selected majors (1986).

Using the same database, Paula R. Knepper broke the time frame down into more detail, such as the years of delay to start college and the years spent in the freshman year. To assure the statistical accuracy, the report has used the t-test on the percentage calculation (1989).

These reports motivated people to pay attention to the degree completion time issue, although most of these reports described phenomena rather than explained the causes. They also began the process of identifying variables which could be examined in more sophisticated empirical studies.

Most studies to date used the cross tabulation method traditionally employed in education studies. They calculated the percentages within the categories of the independent variable and compared these percentages across the categories of the independent variable. If the percentages differ by a significant amount (Some using the usual chi-squared test for independence) between or among the categories, an association is said to exist.

The cross-tabulation only analysis is a good approach when we compare one or two factors at a time. Since the cross-tabulation is a simple statistical method, the explanatory power was limited when dealing with a large vector of explanatory variables.

Lacking in reliable and sufficient records and funds some colleges used student surveys to select data for degree completion time analysis.

The University of California and the California State University sample the students' opinions about factors that contribute to taking longer than four years to earn their bachelor's degree (1988). Similar reports were conducted by the California Post-Secondary Education Commission in 1987 and the University of California, Berkeley in 1987.

In response to "state-mandated matriculation research requirements", the Peralta Community College District conducted a preliminary analysis of the demographics of spring 1990 degree recipients to the time of degree completion based on transcript and survey information (Spinetta 1991). This study replicated and expanded the studies first conducted by Chicago (April 1990) and subsequently by Los Angeles (September 1990).

Grosset documents the enrollment patterns of the 765 spring 1990 associate degree recipients at community colleges of Philadelphia, and provides selected comparisons with the 1982 graduating cohort. In addition, results of a survey of the graduates are reported (1991).

The advantages of a survey study are obvious. It is relatively easy to get the data. The answers are straightforward while the questioner can construct questions directly addressing the interesting points. But the answer will heavily depend on student's objective thinking. For example, most reasons listed by the students can be seen as self-justification rather than objective analysis. The top five reasons listed by the students from Universities of California at Davis and Riverside are (1986):

* Took extra courses out of interest.
* Needed to work.
* Change of major.
* Reduced course load.
* Needing better advising.

There are few students who think that remedial course work or social activities and entertainment delay their graduation.

In recent years there have been several dissertations that addressed this topic. Clara Chann used the loglinear model to determine the relationship between the number of terms of enrollment and selected characteristics of graduates of a community college (1987). The Loglinear model, which he used in his research, is an extension of the traditional cross-tabulation study (Knoke and Burke 1983).

Hortense B. Hinton visited fifteen black graduates and used parallel analysis to identity the factors contributing to on-time graduation (1988). His research provided a good explanation of degree completion time. It is also quite objective. Kimball analyzed the relationship between the relevant factors and time of graduation based on a simple correlation analysis(1991).

Section 3. The Determinants of Degree Completion Time

Previous studies have addressed a cluster of factors that influence the degree completion time. Although the methods that some studies used are quite simple or disputed, they still brought us some pictures which reflect the potential association between some factors and the degree completion time. As a summary, the main factors discussed in the literature are listed as following.

- Demographic Factors:

The factors most often cited in degree completion time studies are demographic factors. Most degree completion time studies report the effect of the demographic aspects (Eckland 1981; Chann 1987; Crawford 1989; Knepper 1989; William 1990; Dillon 1990; Grosset 1991; Spinetta 1991; and etc.). Many studies have provided evidence showing the existence of differences in the degree completion time between demographic groups. These factors include age, gender, and ethnic background.

Age:

Traditional students should enter college immediately after high school graduation, which is around 17 or 18 years old. The older students (more than 18 years old) usually represent nontraditional students. Grosset has found a positive linear relationship between a student's age and the number of years or semesters it takes to finish a degree (June 1991). William obtained the same results in 1991.

It is interesting that Dillon finds that those students entering before age 20 and those entering after age 35 finished most rapidly (1990).

These results are identical with the retention and attrition research. Several retention and attrition studies have found that older students were more likely to drop out than younger students (Sexton 1965; Summerskill and Darling 1955). According to Summerskill (1962) factors that have delayed older students in attending college may continue to contribute to withdrawal, such as family responsibility, financial need, and lacking the basic skills needed for college study.

Gender:

Males and females have different social and family responsibilities. The difference in the degree completion time may imply the effect from these factors. At Peralta Community College District the female students take slightly longer to graduate than male students and they tend to take fewer units per term (Spinetta 1991). Grosset's (1991) and Dillon's (1990) studies confirm this conclusion.

A different result was suggested by Knight at Kent State University, females averaged 11 semesters and males averaged 12 semesters to graduate (1990). Similar results were found by Knepper (1989) and Eckland (1981).

Other studies found little difference between the average time required by men and women to graduate (Chann 1987; Crawford 1989).

Gender is also a quite contradictory determinant in dropout studies. Some studies reveal that males have lower attrition rates (Astin 1964; Tinto 1975; Newlon and Gaither 1980) while some other investigations have found that males are more likely to drop out (Demos 1968; Nelson 1966). Other studies believe there is no significant difference in the overall withdrawal rates between males and females (Summerskill and Darling 1955; Bragg 1956; Iffert 1957; Suddarth 1957; Johansson and Rossman 1973).

Ethnic Background:

The evidence on contribution of ethnicity to degree completion time is ambiguous. Most studies show that Asian students take less time to graduate than students with other ethnic backgrounds (William 1990; Dillon 1990; Grosset 1991). Usually white students take fewer terms to graduate than black students (Chann 1987; Knight 1990).

In Spinetta's study he finds that the Native Americans and whites earned degrees in the least number of terms, followed in order by Asians, Filipinos, Hispanics and African Americans (1991).

In the study of retention and attrition, it was found that the dropout rates for blacks and Hispanics are higher than for whites (Flax 1971; Astin 1975; Lenning 1982; Allen 1987; Attinasi 1989). Other retention and attrition studies have suggested that there is no significant difference between the races (Fetters 1977; Pedrini and Pedrini 1978).

Pre-college Factor:

The factors discussed by the literature are hometown location and aptitude tests. Some scholars have paid attention to these factors because they can be used to predict the degree completion time (Hill 1986; Chann 1987).

Hometown Location:

Surprisingly, there were large differences in the degree completion time in relation to the region where the student attended high school. Chann suggests that residence was one of the strongest factors associated with on-time graduation. He suggested that since out-of-state tuition is higher, the out-of-district students take fewer semesters than the in-district students (1987). From a microeconomic point of view, if we consider college education as an individual investment, the investment of time and money is generally greater for out-of-state students. Thus, to decrease the marginal cost of their education, these students speed up their study.

The findings of retention and attrition studies have suggested that students from rural or out-of-state areas drop out more often (Summerskill 1962; Stork and Berger 1978; Lenning 1982) while other studies cannot support this result (Iffert 1957; Fishman and Pasanella 1960; Johansson and Rossmann 1973).

Aptitude Test:

Fifty-six percent of the bachelor's degree recipients who scored in the highest quartile of the NLS Aptitude Test finished their degree in four years. There was only 25 percent of those who scored in the lower quartile that followed this pattern (Hill 1986). A strong association between ACT score and completion time was revealed by Chann, the higher the ACT scores in natural science, the fewer total terms a student enrolled in college. But the composite ACT score is not significantly related with degree completion time (1987).

On the other hand, we can find similar conclusions in the retention and attrition literature. Most studies conclude that there is a significant relationship between dropout and aptitude test scores (Lenning 1982; Nelson, Scott, and Bryan 1984; Sewell and Shah 1967; Solcum 1956; Summerskill 1962).

College Academic Factor:

College academic factors have the strongest explanatory power in most studies, and are discussed widely in the literature (Chann 1987; Hill 1986; Grosset 1990; Gregory 1990; Spinetta 1991; etc.). College academic factors include total credit hours, grade point average, major, and some special courses.

Total Credit Hours for Graduation:

Surveys from both the University of California system and California State University system mentioned this factor. Students claim that they take extra courses for personal interest, which delays their graduation (1988).

Grosset finds the increase in time to graduate is attributable to the extra credits taken by the students (1990).

Spinetta believes the increase in time to earn a degree is attributable to the fact that students are now earning more units for the degree. It becomes very complex if we analyze the extra credits in detail. Spinetta suggested, "Whether 1990 graduates had to take more remedial courses to improve basic or critical thinking skills before they were able to concentrate on their degree or major requirements than was the case for 1980 graduates or were simply taking more courses not related to the major by choice or because of indecision or lack of direction regarding requirements or recommended course sequence for the major remains to be determined" (1991).

Graduate Grade Point Average:

People intuitively expect good students, those possessing high GPAs, to finish degree requirements sooner than those students with lower GPAs. This has been supported by Grosset's study (1991).

About 7 percent of students in University of California system believe that "failed a course" caused their delay (1988).

Chann's dissertation also arrives at this conclusion and finds actually that it is one of the most important factors (1987).

Contrary to these studies, there is a very slight negative correlation between semesters to degree and GPA in Knight's study (1990).

Summerskill's summary suggests that there are more than 35 retention and attrition studies testing the effect of student's GPA. Most of them proved a significant negative relationship between GPA and dropout (1962).

Major:

A graduate's major also counted as a reason for a difference in the degree completion time in a national study (Hill 1986). But Chann found that a major was not strongly associated with graduation time (1987). Another significant problem which serves to lengthen the time of graduation is changing majors. It is listed as a top reason for delay of graduation by the students from both the University of California system and the California State University system (1988).

Cooperative Education:

Gregory undertook an investigation of the degree completion rates and the retention rates of cooperative education students in eight colleges in Washington and Oregon. Results indicated that, at the four-year colleges, 85 percent of the cooperative students completed their degrees within the 5 years, whereas only 48 percent of the control group students completed their degrees (1990).

Developmental course:

The survey shows, surprisingly, that taking remedial course work causes far fewer delays than repeating courses or changing majors in the California State University system.

Institution Information

Universities vary widely in their four-year graduation rates. Surveys and institutional studies show the different reasons causing delayed graduation among the universities (Hill 1986; Knepper 1989; Kimball 1991; and etc.)

University Pattern and Location:

The proportion of bachelor's degree recipients in four years was much lower from the West (34 percent) than the proportion from the Northeast (60 percent). Graduates from the North Central and Southern States were in the middle at 47 percent (Hill 1986).

Students entering private 4-year colleges were most likely to complete their bachelor degree within the expected time (Knepper 1989). The same result is revealed by Robert H. Kimball in his dissertation (1991).

A study conducted by the Virginia State Council of Higher Education found that students who study at residential universities in rural areas usually take four years to graduate, while students who attend an urban university would like to delay their graduation since there are more chances to work in urban areas(MTSU Sidelines April 5, 1993).

Higher attrition rates have also been found in public colleges (Astin 1975; Lenning 1982). Private college students are probably more reluctant to drop since the investment in private college is higher.

Advising:

Students complain that they need better or more timely advising at the California State University system and the University of California system(1988). Poor advising can increase time to graduation due to extra credits earned and the frequency of changing majors by students.

Class availability:

Class availability is a problem related to the budget of institutions. It is becoming very serious in California due to the state's tight budget. One in three of the respondents from University of California system and California State University system felt that problems in getting required courses on schedule had influenced the time taken to complete their degree. Half of the students rated this influence as "important" or "very important" (1988).

Virginia state officials now are worried about this problem too. They are facing the prospect of an additional 65,000 students by the year 2000.

Enrollment Status

These factors obviously influence degree completion time (Hill 1986; Grosset 1991; Spinetta 1991; and etc.). It will be interesting to see if we can find the exact level of these influences. The factors included here are delayed entrance, transfer, attending summer school, and part-time status.

Delayed entrance:

This factor can be reflected by the student's age when he or she enters college. In Hill's study (1986) students that delay their entrance to college are just as likely to earn a degree within 4 academic years as those who began college in the fall immediately after high school (58 percent for both groups). Knepper confirmed this result (1989).

Transfer:

It has been cited as an important factor in the delay of graduation in the surveys of the California University system (1988). Of graduates who transferred between colleges, 47 percent finished within the traditional time, compared with 54 percent who attended only one college (Hill 1986).

The survey data in California makes clear that transfer students suffer even more delay from certain factors than their counterparts.

Knepper found the transference from one college to another added 8 months or longer to degree completion time, depending upon the type of transfer (1989).

Summer School:

Attending summer school will shorten the total number of fall and spring semesters a student is enrolled in college. Grosset found that most of the students (94.5%) attended at least one summer session at Community College of Philadelphia (June 1991).

Part-Time Status:

The Chronicle of Higher Education Almanac estimates that in 1993, 15.3 million students are attending college, and 6.4 million are going part-time. These numbers are expected to increase until the end of this century.

In Grosset's study, he finds that the delay of graduation is attributed to stopout behavior and fewer credits taken per semester. The mean semester credits earned by 1990 graduates was 8.1 compared with 9.0 for 1982 graduates (June 1991).

An earlier analysis of NLS students who entered academic college programs by the fall after high school, but were still enrolled in college 4.5 years later, indicates 20 percent attended part-time, 14 percent were in 5-year programs, and 35 percent left college and then returned (Hill 1986).

Stopout:

As mentioned above, Grosset believes this is the most important factor. His comparison study indicates that 1990 graduates were more likely than 1982 graduates to have stopped-out for at least one semester at the Community College of Philadelphia. Despite their length of enrollment histories, graduates who stopped-out achieved similar levels of academic success, measured by GPA, as those graduates who attended without interruption.

Family responsibilities related to pregnancies and child care were frequently cited as reasons for stop-out (Grosset 1991).

Around 37.9 percent of the graduates in the University of California at Davis and Riverside said their delay is caused by "Need a break" (1988).

The 1990 cohort stopped out more times and took more medium breaks (one to five years) than the 1980 cohort in Peralta Community College District (Spinetta 1991). Spinetta found only 2% of the 1980 graduating class took a long break (six or more years) before earning a degree, compared to 7% in 1985, and 11% in 1990 (1991).

Financial and Family Problem

Financial needs constitute the most formidable and unwanted delays for undergraduates shown in the many survey reports. As explained by the editor of the MTSU Sidelines (April 5, 1993): "A major factor in the increased time it takes to earn a four-year degree is the fact that federal loan and grant money is being reduced, forcing students to work part-time or full-time to help finance their education expense. In some cases students take an occasional semester off to make money for tuition.".

In Grosset's survey, many of these respondents simply indicated "financial reasons or problems" (1991). The survey on the campuses in California confirms the importance of financial needs. Graduates of the University of California at Davis and Riverside put "Needed to work" as second reason while they put "Ran out of money" as ninth reason. What did they work for, tuition or beer?

But it was found that many students receiving financial aid were not making satisfactory progress in the report to the committee on Labor and Human Resources (1981).

The importance of financial factors in retention has been watched for a long time by scholars. Finances and work commitments were the most frequently cited reasons for graduate stop-out behavior (Grosset June 1991).

Summary of Literature Review

The literature review on degree completion time shows the complexity of this issue. No easy and identifiable solutions can be reached by using simple models.

This issue is related to the study of retention and attrition. In fact, we can treat study of degree completion time as an extension of the research on retention and attrition. They share the same influence from many factors.

The studies regarding the degree completion time are very limited. The literature review on this topic clearly indicates that the studies resemble the early stage of studies on retention and attrition. Most of the studies use the traditional method favored by educators, cross-tabulation, to describe the issue rather than to explain it.

Many studies use survey data, which is relatively easy to collect, but not very reliable. In some studies, several factors are studied simultaneously when it is reasonable to assume that all factors operate together to drive degree completion time.

Overall, the previous studies still have addressed a cluster of factors that relate to degree completion time. By going through the literature we can form a general picture about the potential factors that are associated with degree completion time. Table 2.4.1 summarizes these relationships.

Table 2.4.1.--Potential Relationships Between Some Factors and the Degree Completion Time and Withdrawal from Literature Review.

FACTORS	DEGREE COMPLETION TIME	WITHDRAWAL
AGE	+	+
GENDER (MALE)	-, +, 0	-, +, 0
ETHNIC BACKGROUND	ASIAN<AVERAGE	WHITE<BLACK
	WHITE<BLACK	WHITE<HISPANIC
	WHITE<ASIAN<BLACK	0
HOMETOWN LOCATION (DISTANCE)	-	+, 0
APTITUDE TEST	-	-
TOTAL CREDITS	+	
GPA	-, +	+
CHANGING MAJOR	+	
COOPERATIVE COURSE	-	
DEVELOPMENTAL COURSE	+	
UNIVERSITY LOCATION	NORTHEAST<SOUTHERN	
	SOUTHERN <WEST	
	PRIVATE <PUBLIC	
	RURAL <URBAN	
ADVISING	-	
CLASS AVAILABILITY	-	
DELAYED ENTRANCE	0	
TRANSFER	+	
SUMMER SCHOOL	-	
PART TIME	+	
STOPOUT	0, +	
FINANCIAL AID	-, +	

NOTES: The "+" sign presents a positive relationship. The "-" sign presents a negative relationship. The "0" sign presents no relationship. The "<" sign presents that the students included the left category take less time to graduate than the students included in the right category.

CHAPTER III

METHODS AND DATA PREPARATION

This study aims to extend the research of earlier studies on the degree completion time issue. The author will build regression models by applying econometrics techniques according to the statistical distribution and other characteristics of the dependent variable, the degree completion time. A multivariate regression analysis of the data can measure the strength of association among the characteristics of graduates and the degree completion time.

More specifically, this study will test for the following question by using regression techniques: Is it possible to explain the completion time for bachelor's degree by considering its determinants simultaneously? What kinds of graduates' characteristics are associated with the completion time for the bachelor's degree and how do these variables operate and interact in the degree completion time frame? Can we predict degree completion time by using pre-college and demographic information?

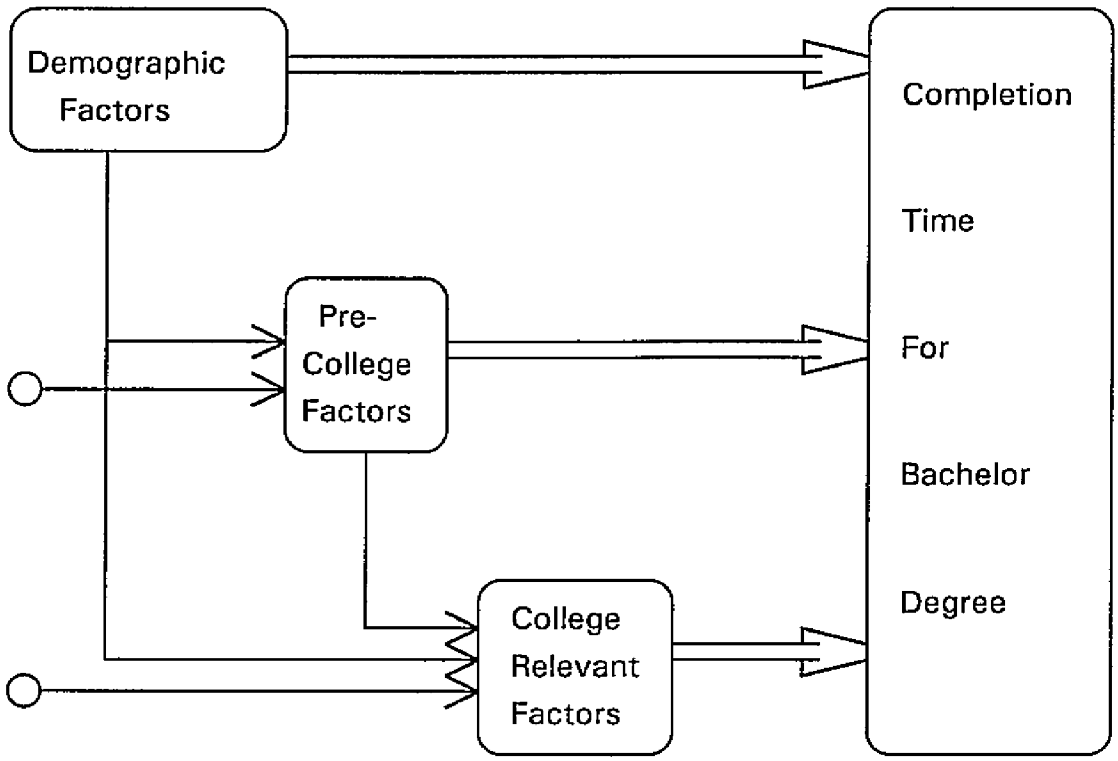

Figure 1. The Basic Model of Degree Completion Time

The Models and Methods

The basic model behind this study can be illustrated in Figure 1. The author assumes the degree completion time is the output of a joint effect among its determinants. These determinants can be categorized into three groups:

demographic characteristics, pre-college, and college relevant factors.

The factors included in the categories may not occur at the same time. There are influences among and within the categories. In general, these factors still can be considered as independent determinants of degree completion time.

Demographic factors are the early determinants. They will have influence on the degree completion time as well as on the pre-college and college relevant factors. Like the determinants of degree completion time, some pre-college factors also can be partly determined by demographic factors. College relevant factors on the one hand are the later period determinants as well as the majors factors. On the other hand, these factors may be determined by demographic, pre-college, and other factors.

The dependent variable, the key variable in this study, is the total semesters a student spends on his or her bachelor's degree. In order to focus on the real college time a student spent on the bachelor's degree, this study will exclude the stopout time.

With these variables in hand, this study will apply an advanced econometrics technique to the basic model in Figure 1 to answer the questions raised in the beginning of this chapter.

This study will start from building the Ordinary Least

Square (OLS) regression model, the most popular and widely available model in statistical analysis. The results from the OLS have a more intuitive interpretation than other more sophisticated models.

Due to the discrete (count) characteristic of the dependent variable, the number of semesters, the OLS model does not entirely fit the data although it can work quite well. Theoretically, we could improve OLS with a model that accounts for these characteristics.

The Poisson regression model has been actively used for such data. The author will test the Poisson Model as an alternative model to explain and predict the degree completion time. A brief introduction to the Poisson regression model will be presented in the last section of this chapter.

Another problem encountered in the OLS model is the positive nature of the dependent variable. The total enrolled semesters in MTSU of a student cannot be negative. The Lognormal regression model is specified to deal with this problem. This model has been widely applied to the length of program participation. This study also will use the Lognormal model to find the relation between the degree completion time and its determinants. The last part of the chapter will discuss the basic concept of the Lognormal model.

The OLS model is a relatively simple technique and it is available in most statistical software. The explanation of the OLS model is very straightforward. For practical purposes, it is useful to measure how much the results will be distorted if we only employ the simple OLS model, and to determine if it is worthwhile to use the more sophisticated model.

To address this question, the author will compare the OLS, Lognormal, Poisson models by applying an out-of-sample prediction test (Maddala 1992). Monte Carlo analysis is used for the comparison among the three models.

Population and Sample

This study selected a sample of the students who graduated at MTSU in Fall 1991, Spring 1992, and Summer 1992. With help from the computer service department, this author collected the data from the MTSU Student Information System (SIS).

The SIS system is a series of indexed sequential files with each of these files containing data to one of four main areas: admission, student records, financial aid and housing, and bills receivable. Each area contains several files. This system has been in operation since 1989, data for earlier years is therefore incomplete.

There are 1,893 students who received the bachelor's degree in the 1991-1992 academic year. One restriction set for the selection of the sample was that only the students who were non-transfers were selected. This is because the records for transfer students lack pre-college information. In addition, most of their college-relevant variables are not reliable. The fatal point is the unreliability of the key variable, total semesters enrolled in college. Therefore this study will focus on the students who completed all their bachelor degree courses at MTSU. After deleting the observations which included uninterpretable records and missing values, the sample includes 631 subjects.

Middle Tennessee State University is one of the fastest growing public universities in the United States. It is located in Murfreesboro, a historic city with a population of 41,000, 32 miles southeast of Nashville. MTSU was founded in 1909.

The university enrolled 15,673 students in the fall of 1991. Seventy-five percent of all students enrolled were full-time students. Women were the majority at the university, accounting for fifty-three percent of enrollments. Minority (non-white) students represented 11.7 percent of the university's enrollment. The average age of the students was 25.4 year old.

Univariate Analysis of the Data

This segment will provide a univariate analysis of the data collected in this study. After reviewing the literature, discussing with the dissertation committee, and going through the SIS system at MTSU, the author selected the primary determinants from the SIS system. They can be categorized into three groups: demographic characteristics, pre-college factors, and college relevant factors, and are listed in Table 3.3.1 by groups. A detailed discussion of these factors and the reasons for selecting them are given in the following.

Table 3.3.1.--The Factors to be Tested as Determinants of Degree Completion Time

GROUP	FACTORS
Demographic Factor:	Age, Gender, Ethnic Background
Pre-college Factor:	ACT score, High School Grade point Average, Home Town Location, Veteran
College Related Factor:	Extra Credits, Graduate Grade point Average, Degree Type, Majors and the Declaring time, Change Major, Minor, Developmental Course, Cooperative Course, Course Withdrawal, Course Failed, Financial Aid, Times Attended Summer School, Stopout

Demographic Variables

Demographic variables selected in this study include gender, age, and ethnic background. Earlier studies suggest that they significantly influence degree completion time. These factors are important not only because of their contribution to degree completion time, but also because they supposedly have influence on other pre-college and college relevant factors. Therefore, these factors are used to build some interaction terms with other factors.

Age:

The degree completion time should positively correlate with the student age according to previous studies. Usually, younger students have more energy to concentrate on studying while the older students may have more family responsibility. The older student may have some problems in meeting the admission requirements as well as academic competence. It also will take time for them to refresh basic study skills and knowledge.

At MTSU, as an admissions requirement, all the applicants who are 21 years or older at the time of their admission are required to take the Academic Assessment Placement Program (AAPP) exam. On the basis of their test scores, students are placed in basic, developmental, or college level courses.

To avoid double counting, the author used the student's age at the time of their admission. The oldest student in this study was 28 years and the youngest was 17 years. The average age was about 18.5 years old (refer to Table 3.3.2).

Table 3.3.2.--Graduates by Age

AGE	FREQUENCY	PERCENT
17	13	2.1
18	362	57.3
19	233	37
20	17	2.6
21	2	0.4
22	3	0.4
28	1	0.2

Ethnic Background:

Most studies suggest that the student's ethnic background should influence degree completion time. Usually, white students take fewer terms to graduate than black students (Chann 1987; Knight 1990). MTSU is predominately a white student institution: 572 (90.6 percent) subjects are white students and 54 (8.6 percent) are black (refer to Table 3.3.3). The subjects who reported their ethnic origin as Asian or Pacific Islanders, American Indian, Hispanic, and nonresident alien are included in the "other" category, which are only 5 students (0.8 percent). Therefore the influence from ethnicity may not be very significant in this study.

Table 3.3.3.--Graduates by Ethnic Origin

RACE	FREQUENCY	PERCENT
White	572	90.6
Black	54	8.6
Other	5	0.8

Gender:

As we know from the literature survey, the relationship between degree completion time and gender is ambiguous. Male and female students have different social and family responsibilities. The female student is more likely to stop out to care for children while the male student is more likely to drop out for a full time job. The majority of graduates at MTSU were female in the 1991-1992 academic year. Of the total sample of 631 subjects, 362 (57.4 percent) were female and 269 (42.6 percent) were male (refer to Table 3.3.4).

Table 3.3.4.--Graduates by Gender

SEX	FREQUENCY	PERCENT
Male	269	42.6
Female	362	57.4

Pre-College Factors

Pre-college factors primarily come from high school information, including high school grade point averages, ACT scores, and hometown location. Veteran status was also included in this category. Since we can obtain this information in the early stages of student enrollment, our administrators and student advisers can utilize them as an advanced signal for delayed graduation.

ACT Score:

Aptitude scores are a very good predictor for a student's performance since it partly reflects the student's intelligence. A previous study also found that a high aptitude score will result in quick graduation (Hill, 1986). According to Chann's study, the components of ACT score, especially the natural science part, are more important than the composite ACT score in explaining the degree completion time. Unfortunately, the SIS system in MTSU only keeps the composite ACT score for the subject.

At MTSU, all freshman applicants who have composite ACT scores of 18 or below are required to take the AAPP exam as a part of their admission requirements. On the basis of their test scores, students are placed in basic, developmental, or college level courses.

The highest score in this sample is 30 while the lowest is 12 (refer to Table 3.3.5). The average ACT score of the subjects in this study is 20.9.

Table 3.3.5.--Graduates by Composite ACT Score

ACT SCORE	FREQUENCY	PERCENT
18 or below	122	19.3
19	105	16.6
20	62	9.8
21	107	17.0
22	49	7.8
23	54	8.6
24	38	6.0
25	32	5.1
26	23	3.6
27 or above	39	6.2

High School Grade Point Average:

This factor is similar to the ACT score, but it is debatable in terms of interpretation. Sometimes, low high school GPAs may result from a strict grading system in a prestigious high school. If we can get the high school ranking, it may give us a clearer picture. Of the 631 subjects, 494 subjects (78.3 percent) reported their high school grade point averages. The lowest high school GPA was 1.55 and the highest was 4.00 in this sample. The average high school GPA score was 3.13 (refer to Table 3.3.6).

Table 3.3.6.--Graduates by High School Grade Point Average

HIGH SCHOOL GPA	FREQUENCY	PERCENT
0.0 or above (below 2.0)	10	2.0
2.0 or above (below 2.5)	49	9.9
2.5 or above (below 3.0)	106	21.5
3.0 or above (below 3.5)	202	40.9
3.5 or above	127	25.1

Veteran:

Military experience should have a big impact on every person who is a veteran. It may change a person's lifestyle, intelligence, maturity. Unfortunately, the records collected from the SIS appear to be unreliable. The percent of students listed as veterans, is extremely small: 0.3 percent (refer to Table 3.3.7).

Table 3.3.7.--Graduates by Veteran Status

	FREQUENCY	PERCENT
Veteran	2	0.3
Non-veteran	629	99.7

Home Town Location:

This is an interesting variable; many experts believe the farther away the home town is located from the university, the more quickly a student will finish his or her degree since the investment of the student is greater. A local student is also more likely to drive back home on weekends.

Of the 631 subjects, 529 (83.8) come from the a high school in Tennessee or their permanent address is located in Tennessee (refer to Table 3.3.8). Part of the hometown location data in the MTSU SIS system is missing. So the author combined it with the high school location as the data set in this study.

Of the 631 subjects, 529 (83.8 percent) originally lived in Tennessee and 102 subjects lived out of Tennessee before admission to MTSU.

Table 3.3.8.--Graduates by Home Town Location

LOCATION	FREQUENCY	PERCENT
Tennessee	529	83.8
Out of Tennessee	102	16.2

College Relevant Factors

As suggested by previous studies, college relevant factors can be the main determinants of degree completion time. They may not be used as predictors for degree completion time when the students are admitted. But we can use them to analyze the reasons for the delay of graduation. The results can help our administrators in reviewing and revising policies and practices for preventing the delay of graduation. The college relevant factors collected for this study include major and minor information, graduate grade point average, extra credit above degree requirement, semesters enrolled in summer school, number of semesters stopped out, total courses withdrawn and failed, total developmental courses and cooperative courses, and financial aid status.

Extra Credit Above Bachelor's Degree Requirement:

Many students claimed the delay of their graduation was caused by the extra credits they took. This is only a superficial phenomenon. The extra credits can be caused by changing majors, having a minor, taking developmental courses, repeating failed courses, transfer, or taking courses out of personal interest. This study tries to separate these effects.

MTSU requires 132 semester hours to graduate. The extra credits listed in Table 3.3.9 do not include developmental courses or the first failure in any course. More than half of the subjects have taken no more than 3 extra credit hours. About 19 subjects (2.9 percent) have had 39 or more extra credit hours.

Table 3.3.9.--Graduates by Extra Credits Above the Bachelor's Degree Requirement

EXTRA CREDITS	FREQUENCY	PERCENT
0	180	28.5
1-3	168	26.7
4-6	74	11.7
7-9	48	7.6
10-12	27	4.3
13-15	29	4.6
16-21	35	5.5
22-27	26	4.1
28-39	25	4.0
39 or more	19	2.9

Graduate Grade Point Average:

The reason justification for using grade point averages in this study is that GPA stands as a college performance measurement of the students. Graduate GPA reported by the subjects used in this study represent the average of all grades received in courses taken to meet program requirements for graduation. MTSU requires a 2.00 GPA to graduate (refer to Table 3.3.10). About one third of the subjects had their GPA higher than 3.0. The average GPA of the subjects is 2.84.

Table 3.3.10.--Graduate by Grade Point Average

GPA	FREQUENCY	PERCENT
2.0 or more (below 2.5)	155	24.6
2.5 or more (below 3.0)	257	40.7
3.0 or more (below 3.5)	160	25.3
3.5 or more	59	9.4

Degree Type:

Courses in natural science usually require more mathematics background. It is interesting to examine the relationship between degree type and completion times. In Table 3.3.11, the category titled degree in science includes the students who graduated with a B.S. or a B.S.N. degree; another category includes all other graduates in this sample (refer to Table 3.3.11). Of the 631 subjects, 420 (66.6 percent) graduated with a B.S. or a B.S.N. degree.

Table 3.3.11.--Graduates by Degree

DEGREE OF	FREQUENCY	PERCENT
Science	420	66.6
Non-Science	211	33.4

Declaring Academic Major:

A student who has clear personal goals and interests supposedly takes few irrelevant courses that might delay graduation. The point at which a student declares his or her major may partly reflect this factor. In this study, most subjects (619) had declared their major in their first semester (refer to Table 3.3.12).

Table 3.3.12.--Graduates by Declaring Major in First semester:

DECLARING MAJOR	FREQUENCY	PERCENT
Yes	619	98.1
No	12	1.9

Change Major:

Changing majors is a very important reason for delay of graduation in the survey studies. Obviously, this behavior will cause students to take more courses. Of the 631 subjects in this study, 475 subjects (75.3 percent) had never changed their major, and one quarter (156) of the subjects changed their major at least one time (refer to Table 3.3.13).

Table 3.3.13.--Graduates by Number of Times Changing Major:

TIMES CHANGE MAJOR	FREQUENCY	PERCENT
0	475	75.3
1	114	18.1
2	13	2.1
3	22	3.5
4 or more	7	1.1

Academic Minor

Although choosing an academic minor should postpone graduation, it is not a bad thing. This study will address the effect from this factor on the degree completion time. Of the 631 subjects, 522 subjects (83.7 percent) had one or more academic minors, 109 subjects (17.3 percent) did not have any minor (refer to Table 3.3.14).

Table 3.3.14.--Graduates by Academic Minor

	FREQUENCY	PERCENT
With Minor	522	82.7
Without Minor	109	17.3

Developmental Courses:

There are three aspects from developmental courses that have an influence on degree completion time. First, the extra credit from taking the developmental courses will delay graduation. Second, the improved academic skills obtained from the developmental courses will speed up graduation. Third, the student enrolled in the developmental courses are defined as under-prepared to enter the regular college curriculum. So these students may not be categorized into high intelligence student groups, who can finish degree requirements relatively quickly.

At MTSU, developmental courses are awarded institutional credit which does not count toward the 132 hours required for an undergraduate degree. Developmental course grades are also not used in the computation of the

2.00 GPA required for a bachelor's degree. Students may not take any college-level course which requires skill in any area in which they show a deficiency as determined by the Academic Assessment Placement Program (AAPP). Less than half of the subjects (43.9 percent) had taken the developmental courses in this sample (refer to Table 3.3.15).

Table 3.3.15.--Graduates by Number of Developmental Courses Taken

TOTAL COURSES	FREQUENCY	PERCENT
0	354	56.1
1	108	17.1
2	44	7.0
3	23	3.6
4	23	3.6
5	29	4.6
6	26	4.1
7 or more	24	3.8

<u>Cooperative Course</u>:

By looking at the influence coming from cooperative courses, we can get an alternative measurement of the effect the student's working experience has on the degree completion time. It may not be a very important factor at

MTSU since only a few students have had this experience. Of the 631 subjects, only 14 subjects (2.2 percent) have had cooperative courses (refer to Table 3.3.16).

Table 3.3.16.--Graduates by Number of Cooperative Courses Taken

TOTAL COURSES	FREQUENCY	PERCENT
0	617	97.8
1	2	0.3
2	2	0.3
3	9	1.4
4	1	0.2

Course Withdrawal:

Every semester the registrar's office at all universities is burdened with students who engage in dropping courses. Although it has been described as a nightmare, it is a part of the registration process. The course withdrawal discussed in this study is defined as a student dropping from a course during the fifth through the eighth week of a term. Of the 631 subjects, 415 subjects (65.5 percent) had never dropped any course (refer to Table 3.3.17).

Table 3.3.17.--Graduates by Number of Course Withdrawals

TOTAL COURSES WITHDRAWAL	FREQUENCY	PERCENT
0	415	65.8
1	145	23.0
2	43	6.8
3	15	2.4
4 or more	13	2.1

Course Failed:

This measure can not be fully reflected by graduate GPA. According to MTSU's academic regulation, the first failure in a course does not count toward the 132 hours required for an undergraduate degree and is not used in the computation of the 2.00 GPA required for a bachelor's degree. However, repeated failure in a course will be used to calculate the graduate GPA. More than half of the students in this sample had the experience of failure in at least one course (refer to Table 3.3.18). About 29 subjects (3.5 percent) had failed more than 8 courses.

Table 3.3.18.--Graduates by Number of Course Failures

TOTAL COURSES FAILED	FREQUENCY	PERCENT
0	292	46.3
1	99	15.7
2	72	11.4
3	42	6.7
4	29	4.6
5	25	4.0
6	17	2.7
7	10	1.6
8	16	2.5
9 or more	29	3.5

Financial Assistance:

As we can see from the literature review, the financial problem is crucial. Many studies find that degree completion time is directly affected by how a student finances his or her education expenses. The information kept in the MTSU SIS system is limited. Some factors, such as family income, and the degree to which a student depends upon his or her family, may only be obtained by survey. The variable employed in the present study is whether or not a student received financial assistance. This financial aid includes the assistance based on the federal regulations defined in Title IV (refer to Glossary) and other assistance. More than a quarter of the subjects received financial assistance during at least one semester (refer to

Table 3.3.19).

Table 3.3.19.--Graduates by Financial Assistance

	FREQUENCY	PERCENT
Received	174	27.6
Not Received	457	72.4

<u>Stopout</u>:

There are many reasons for a student to stop out. Obviously, the stopout behavior will expand the time range from admission to graduation. This study is interested in the effect of stopout on the actual length of time a student spends on his undergraduate education.

Stopout in this study is defined as the total spring and fall semesters that a student did not consecutively register for any courses from admission to graduation (refer to Table 3.3.20). About 22.3 percent (141 students) have stopout experience.

Table 3.3.20.--Graduates by Number of Semesters Stopout

TOTAL STOPOUT SEMESTER (FALL AND SPRING)	FREQUENCY	PERCENT
0	490	77.7
1	67	10.6
2	20	3.2
3	17	2.7
4 or more	37	5.9

Summer School:

Summer school is not traditionally a formal school. A student who goes to summer school can shorten his or her graduation time. Some studies suggest that summer school is very important for a student who wants to graduate quickly, since summer courses are easier than the courses in fall and spring. This study is interested in finding out how many regular semesters (fall and spring) a student can save by attending summer school.

Most of the students in our sample (about 525 subjects or 83.2 percent) had attended summer school at least one time (refer to Table 3.3.21).

Table 3.3.21.--Graduates by Number of Times Attended Summer School

TIMES	FREQUENCY	PERCENT
0	106	16.8
1	173	27.4
2	165	26.1
3	133	21.1
4	44	7.0
5	8	1.3
6	2	0.3

Degree Completion Time Measurement:

There are several ways to define the degree completion time. This study is interested in the actual time that a student spent on his or her bachelor's degree. Measuring time to graduation in terms of years from admission to graduation will overestimate the actual time. Some students do not attend in consecutive semesters but instead stopout for one or several semesters during their enrollment. In order to adjust time to graduation to account for intermittent attendance, this study will use the total number of fall, spring and summer (one summer semester is counted as a half semester) semesters in which the student actually enrolled at MTSU as the dependent variable.

Only 37 subjects (5.9 percent) graduated within 8 semesters (refer to Table 3.3.22). Almost half of the students in this sample (49 percent) spent more than 10 semesters to finish their degree. 35 subjects (5.5 percent) spent more than 15 semesters. As a comparison Table 3.3.23 lists the total years from admission to graduation (including the stopout years) that a subject spent.

Table 3.3.22.--Graduates by Total Semesters Enrolled (Summer School counted as a Half Semester)

TOTAL SEMESTER	FREQUENCY	PERCENT
7.5	7	1.1
8	30	4.8
8.5	47	7.4
9	69	10.9
9.5	71	11.3
10	88	13.9
10.5	73	11.6
11	47	7.4
11.5	45	7.1
12	36	5.7
12.5	32	5.1
13	11	1.7
13.5	11	1.7
14	16	2.5
14.5	13	2.1
15 or more	35	5.5

Table 3.3.23.--Graduates by Total Years Duration from Admission to Graduation

TOTAL YEARS	FREQUENCY	PERCENT
4.0 or less	165	26.1
5.0 or less (above 4.0)	280	44.4
6.0 or less (above 5.0)	90	14.3
7.0 or less (above 6.0)	40	6.3
More than 7.0	56	8.9

Introduction to the Statistical Tools

Poisson Model:

Due to the discrete characteristics of the independent variable, the Poisson regression model has been used to analyze count data. The model assumes that each value, i, of the dependent variable is drawn from an independent Poisson distribution with parameter λ_i. Hence, the probability of $Y_i=y_i$ is given as:

$$\mathrm{Pr}ob(Y_i - y_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!}, \qquad y_i = 0,\ 1,\ 2,\ldots$$

In this study, y_i can be 7 semesters, 8 semesters, etc. The equation determining λ_i, the only parameter of the Poisson distribution, is usually assumed to be:

$\ln \lambda_i = \mathrm{B}' X_i$ or $\lambda_i = \exp(\mathrm{B}' X_i)$

B′ is the vector of coefficients, X_i is the matrix of the regressors. By applying Maximum Likelihood techniques, we can estimate the parameters of λ_i.

For predictive purposes in this study, we need to compute the probability of all the possible semesters for a student by using the estimated parameters. The one with the highest probability is the predicted semester. For a full discussion, see William Greene's Econometric Analysis (1990, 707).

Lognormal Model:

The Lognormal model is defined only for positive values of dependent variables. The general form of the Lognormal model is similar to the OLS model:

$$Y = B'X + \varepsilon$$

For the Lognormal model, we assume the distribution of y_i is Lognormal with its variance proportional to the square of its mean

$$E(Y) = B'X$$

$$Var(Y) = \sigma^2 (B'X)^2$$

The density function for the Lognormal model, unlike that for the normal distribution, is asymmetric, exhibiting a long tail in the positive direction. By applying the maximum likelihood techniques, we can estimate the coefficients in the B metrix. For a detailed discussion, see Peter Maddala's A Guide to Econometrics (1977) or T.

Amemiya's article (1973).

Treatment Effects:

Treatment effects are an important approach to correct for selection bias (Greene 1990). To capture the idea of this new technique, consider the analysis of the effect of financial aid on the degree completion time.

$$Y_i = B' X_i + c Z_i + \varepsilon_i$$

Z_i is a dummy variable, equal to one for a student having financial aid and zero otherwise. Contrary to popular belief, c, the coefficient of Z, does not measure the impact of financial aid on degree completion time. This is because that the study embodies the assumption: without financial aid, recipients would take as long as non-recipients. However students who get financial aid usually would have taken more time than non-recipients to finish their degree if they had not received financial aid. Hence, in using OLS we will underestimate the effect of financial aid on degree completion time.

To solve this problem, we can use Heckman's two-step estimation technique in the sample selection model. First, the dummy variable, Z_i, which is financial aid can be estimated by the Probit model:

$$D_i = a' W_i + v_i$$

where $Z_i = 1$ if $D_i > 0$ and $Z_i = 0$ if $D_i \leq 0$

W_i, represents the determinants of financial aid. In this study we used the demographic and pre-college factors as the determinants of financial aid. From the first-step (Probit) equation, one can derive the Inverse Mills' Ratio (IMR). IMR has to be estimated for both $Z_i = 1$ and $Z_i = 0$.

$$IMR_i(1) = \frac{\phi(a' W_i)}{\Phi(a' W_i)} \text{ for } Z_i = 1$$

$$IMR_i(0) = -\frac{\phi(a' W_i)}{1 - \Phi(a' W_i)} \text{ for } Z_i = 0$$

where ϕ is the standard normal density and where Φ is the normal cumulative distribution function. The two IMRs are then used as additional regressors in the simple OLS regression,

$$Y_i = B' X_i + c Z_i + g(IMR_i(1) - IMR_i(0)) + \varepsilon_i$$

The sum of cZ_i and $g(IMR_i(1) - IMR_i(0))$ gives the corrected estimate for the effect of financial aid.

CHAPTER IV

EMPIRICAL ANALYSIS

Variables

The purpose of this chapter is to report the process and findings of the empirical analysis by using the model described in Chapter III. The description of the factors and the reasons each was included in this study were presented in the previous chapter. In this section, the author will describe the way that the variables are used and their parameters.

The dependent variable is the number of the total semesters a student spent on his or her bachelor's degree (TOTAL). The summer semester is calculated as half semester. In the Poisson model, TOTAL16 (equal to TOTAL*2) is used as dependent variable because of the integer nature of dependent variable. TOTAL16 is censored at 30.

This study intends to explain the degree completion time by three groups of factors (refer to Table 3.3.1). The demographic factors consist of the variables: AGE (measured as the student's first time enrolled at MTSU), BLACK (one represents black students and zero otherwise), OTHERACE (one represents the students who reported their ethnic origin as

Asian Pacific Islanders, American Indian, Hispanic, or nonresident alien and zero otherwise), and SEX (one represents male student and zero otherwise).

The pre-college variables include TN (one represents a student's hometown is located in Tennessee and zero otherwise), MILITARY (one represents a student veteran and zero otherwise), ACT (student's ACT score), and HSGPA (student's high school grade point average).

The college relevant factors include thirteen variables. Four of them are dummy variables: BS (one represents a student that got a bachelor degree in science and zero otherwise), DGETFIN (one represents a student that got financial aid and zero otherwise), DMINOR (one represents a student that graduated with a minor and zero otherwise), and DNOMAJOR (one represents a student that did not declare a major in his or her first semester at MTSU and zero otherwise)

The other college relevant variables are CMAJOR (times a student changed his or her major), COOPERAT (total cooperative courses a student has taken),DEVELOP (total developmental courses a student has taken), EXTRAC (the extra credits a student earned beyond the degree requirement divided by the CMAJOR+DMINOR+1:

$$EXTRAC = \frac{(total\ credits) - 132}{CMAJOR + DMINOR + 1} \quad 4.1$$

The total credits are the total credits a student earned at MTSU for his or her degree (not including the credits earned from developmental courses and the credits from first failure of a course), GOSUMMER (times a student went to summer school), STOPSEME (total fall and spring semesters a student had stopped out), and WITHDRAL (total course withdrawals at MTSU).

This study will test the influence on degree completion time from some second power variables. Some interaction terms between dummy variables and other variables are analyzed in this study. A summary of the variables is provided in Appendix B. The means and variances of the variables are described in Table 4.1.1:

Table 4.1.1.--Variable Characteristics

VARIABLE	OBSERVATION	MEAN	STD DEV
ACT	631	20.933439	3.2716203
AGE	631	18.483280	0.7287658
BLACK	631	0.0855784	0.2799625
BS	631	0.6656101	0.4721510
CMAJOR	631	0.3755943	0.8106280
COOPERAT	631	0.0586371	0.4079185
DEVELOP	631	1.3708399	2.2464164
DGETFIN	631	0.2757528	0.4472473
DMINOR	631	0.8272583	0.3783237
DNOMAJOR	631	0.0190174	0.1366945
EXTRAC	631	4.1342804	7.5939428
FAIL	631	2.0475436	3.3076567
FANDS	631	9.8827258	2.1064232
GOSUMMER	631	1.7908082	1.2487369
GPA	631	2.8419493	0.4591896
HSGPA	494	3.1331980	0.5041188
MILITARY	631	0.0031696	0.0562543
OTHERACE	631	0.0079239	0.0887334
SEX	631	0.4263074	0.4949319
STOPSEME	631	0.8858954	2.8342065
TN	631	0.1616482	0.3684198
TOTAL	631	10.778130	2.2319606
WITHDRAW	631	0.5546751	1.0895344
ACTSQ	631	448.89540	140.23642
AGESQ	631	342.16192	29.243261
CMAJSQ	631	0.7971474	2.7027425
COOPSQ	631	0.1695721	1.2604206
DEVEDQ	631	6.9175911	17.478409
EXTRSQ	631	74.668850	420.53706
FAILSQ	631	15.115689	50.561679
GPASQ	631	8.2871967	2.6842795
GOSSQ	631	4.7638669	5.3632814
STOPSQ	631	8.8048072	56.003517
WITHSQ	631	1.4928685	7.2497091
CMABLACK	631	0.0396197	0.3187513
CMASEX	631	0.1600634	0.5617908
CMATN	631	0.0760697	0.4108618
GOSBLACK	631	0.1553090	0.6182152
GOSSEX	631	0.7068146	1.1675240
GOSTN	631	0.3740095	1.0171028
STOBLACK	631	0.0581088	0.5604269
STOSEX	631	0.4804543	2.2357458
STOTN	631	0.3304279	1.8428422
WITBLACK	631	0.0602219	0.3688497
WITSEX	631	0.2995246	0.9175449
WITTN	631	0.1204437	0.7114107

The Selection of The Preferred Model

This study will use the approach suggested by D. F. Hendry (1979). It is called a "top-down" or "general to specific" approach. We start with a very general model which is "overparametrized". The model is then progressively simplified with a sequence of "simplification tests" (Maddala 1992)

OLS model:

The sequences of restriction tests of the OLS model are shown in Table 4.2.1, 4.2.2. The significance level of the first F statistic for a joint test of restrictions is 0.0870 (Table 4.2.1). The significance level of the second F test is 0.5779 (Table 4.2.2). We cannot reject either restriction.

The preferred model is presented in the Table 4.2.3. The variance covariance matrix of the OLS estimate is adjusted as a heteroskedasticity consistent estimate (Kennedy 1987). To analyze multicollinearity, this study calculates the condition number, a measurement suggested by D. E. Belsley et al. (1980). The condition number of a matrix is the square root of the ratio of the largest to the smallest characteristic root:

$$\gamma = \left(\frac{\lambda_{\max}}{\lambda_{\min}} \right)^{1/2}.$$

Belsley et al. suggest computing this ratio for the moment matrix $X'X$ (X is the data matrix). The greater the intercorrelation among the variables, the higher will be the condition number. Since the condition number without the squared variables is 26.8, multicollinearity among the factors do not seem to create instability. The adjusted R-squared and the F-test for regression suggest that the model fits the data quite well.

Table 4.2.3 also presents the standardized coefficients (refer to Equation 4.1.2 and 4.1.3) and associated marginal effects (refer to Equation 4.1.4 and 4.1.5) and elasticities (refer to Equation 4.1.6 and 4.1.7). The formulas used to calculate these parameters are described below:

The standardized coefficient is calculated as follows:

$$\hat{\beta}_j^* = \hat{\beta}_j \frac{s_{x_j}}{s_y} \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.1)$$

where $\hat{\beta}_j^*$ is the standardized coefficient for variable x_j, and $\hat{\beta}_j$ is the coefficient from the original (un-standardized) regression model. s_{x_j} is the standard deviation of variable x_j and s_y is the standard deviation of the dependent variable (Pindyck and Rubinfeld 1991). The interpretation is relatively straightforward. A standard coefficient of 0.2 implies that a 1 standard deviation increase in the independent variable leads to a 0.2 standard deviation increase in the dependent variable. In this study, to avoid the negative value of dependent variable in the Lognormal model, the author did not standardize the dependent variable. Therefore the standardized coefficient calculated in this study can be interpreted as: a standard coefficient of 0.2 implies that a 1 standard deviation increase in the independent variable leads to a 0.2 increase in the degree completion time. So the alternative equation for the standardized coefficient is:

$$\hat{\beta}_j^{**} = \hat{\beta}_j s_{x_j} \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.2)$$

The variance of the $\hat{\beta}_j^{**}$ is:

$$\sigma_{\hat{\beta}_j^{**}} = \sigma_{\hat{\beta}_j} \left(s_{x_j} \right)^2 \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.3)$$

where $\sigma_{\hat{\beta}_j}$ is the variance of $\hat{\beta}_j$.

The equation to calculate the marginal effect is:

$$M_j = \hat{\beta}_j + 2\hat{\beta}_{jj} \overline{x}_j \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.4)$$

where $\overline{x}_j$ is the mean of variable x_j and $\hat{\beta}_{jj}$ is the coefficient of the second power variable of x_j.

The variance of the marginal effect is:

$$\sigma_{m_j} = \sigma_{\hat{\beta}_j} + 4\overline{x}_j \sigma_{\hat{\beta}_j \hat{\beta}_{jj}} + \left(2x_j\right)^2 \sigma_{\hat{\beta}_{jj}} \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.5)$$

where is $\sigma_{\hat{\beta}_j \hat{\beta}_{jj}}$ is the covariance between $\hat{\beta}_j$ and $\hat{\beta}_{jj}$.

The equation to calculate the elasticity is:

$$E_j = \left(\hat{\beta}_j + 2\overline{x}_j \hat{\beta}_{jj}\right)\frac{\overline{x}_j}{\overline{y}} \qquad j=2,\ 3,\ \ldots,\ k \qquad (4.1.6)$$

where $\overline{y}$ is the mean of dependent variable.

The variance of the elasticity is:

$$\sigma_{e_j} = \left(\sigma_{\hat{\beta}_j} + 4\overline{x}_j \sigma_{\hat{\beta}_j, \hat{\beta}_{jj}} + \left(2\overline{x}_j\right)^2 \sigma_{\hat{\beta}_{jj}}\right)\left(\frac{\overline{x}_j}{\overline{y}}\right)^2 \qquad j=2,\ \ldots,\ k \quad (4.1.7)$$

The standardized coefficient is used to compare the relative effect on the degree completion time of each variable. The marginal effect is mainly used to interpret the effect from discrete variables. Elasticities are mainly used for interpretation of continuous variables.

Lognormal Model:

The sequences of restriction tests of the Lognormal model are displayed in Table 4.2.4 and 4.2.5. The significance level of the first Wald statistic for the joint test of restrictions is 0.2631. The significance level of the second Wald statistic for the joint test of restrictions is 0.6811. So we cannot reject either restriction.

The preferred model, standardized coefficients, and associated marginal effects and elasticities are presented in Table 4.2.6.

Poisson Model:

The sequences of restriction tests of the Poisson model are shown in Table 4.2.7 and 4.2.8. The significance level of the first Wald statistic for the joint test of restrictions is 0.9976. The significance level of the second Wald statistic for the joint test of restrictions is 0.5013. We cannot reject either restriction.

The preferred model is presented in Table 4.2.8. The significance of the goodness of fit statistics Chi-squared and G-squared suggest the strong explanatory and predictive power of this model. The Cameron and Trivedi test suggests that there is a over- or underdispersion problem in this Poisson model, which is that the mean and variance of the dependent variable y_i is not equal. Theoretically we can improved Poisson model by using a Negative Binomial model (Cameron and Trivedi 1990). The Negative Binomial model is an extension of the Poisson model which allows the variance of the y_i to differ from the mean. The Negative Binomial model often presents convergence problems in estimation and this study is not exceptional.

Table 4.2.1.--First F-test For the Restriction of OLS Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	-4.2339	(-0.504)	-0.33744	(-0.042)
ACT	-0.49097	(-2.731)	-0.43338	(-2.460)
AGE	2.1936	(2.827)	1.7271	(2.352)
CMAJOR	0.12911	(0.824)	0.17184	(2.772)
COOPERAT	-0.58102	(-0.851)	0.14947	(1.206)
DEVELOP	0.09230	(1.401)	0.03749	(1.099)
EXTRAC	0.15360	(12.111)	0.15172	(12.067)
FAIL	0.29547	(6.835)	0.29758	(7.527)
GPA	-2.1775	(-1.627)	-2.0656	(-1.555)
GOSUMMER	0.09429	(0.742)	0.02987	(0.261)
STOPSEME	0.46072	(7.305)	0.42930	(9.152)
WITHDRAW	0.13269	(1.350)	0.18913	(3.863)
BLACK	0.02715	(0.082)	-0.16355	(-0.884)
BS	0.05012	(0.458)	0.03285	(0.304)
DGETFIN	-0.39334	(-3.385)	-0.39192	(-3.434)
DMINOR	0.86412	(5.634)	0.86097	(5.654)
DNOMAJOR	0.49674	(1.346)	0.44316	(1.208)
MILITARY	-0.76734	(-0.833)	-0.37522	(-0.428)
OTHERACE	-0.40008	(-0.709)	-0.51113	(-0.919)
SEX	0.12614	(0.677)	-0.23552	(-0.217)
TN	0.34905	(1.245)	-0.13446	(-0.965)
ACTSQ	0.01099	(2.725)	0.00942	(2.392)
AGESQ	-0.05548	(-2.851)	-0.04328	(-2.364)
CMAJSQ	0.03184	(0.688)	-----	
COOPSQ	0.23978	(1.090)	-----	
DEVESQ	-0.00698	(-0.909)	-----	
EXTRSQ	-0.00093	(-4.361)	-0.00085	(-3.987)
FAILSQ	-0.00379	(-1.379)	-0.00420	(-1.865)
GPASQ	0.29270	(1.306)	0.28161	(1.264)
GOSSQ	0.03841	(1.308)	0.03538	(1.300)
STOPSQ	-0.01293	(-5.406)	-0.01384	(-6.209)
WITHSQ	0.01115	(0.653)	-----	
CMABLACK	-0.26583	(-1.370)	-----	
CMASEX	-0.02144	(-0.166)	-----	
CMATN	-0.08393	(-0.547)	-----	
GOSBLACK	-0.13775	(-0.847)	-----	
GOSSEX	-0.01748	(-0.203)	-----	
GOSTN	-0.28513	(-2.487)	-----	
STOBLACK	0.12168	(1.143)	-----	
STOSEX	-0.10584	(-2.732)	-----	
STOTN	0.06574	(1.517)	-----	
WITBLACK	0.16414	(0.906)	-----	

Table 4.2.1.--Continued

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL
WITSEX	-0.07054	(-0.639)	-----
WITTN	0.05550	(0.472)	-----
Observation: 631			
R-squared:	0.7272		0.7159
Adjusted R-squared:	0.7072		0.7032
F-test for Regression:	36.39 [43, 587]		56.28 [27, 603]
Prob of F-test:	0.00000		0.00000
Log-likelihood:	-0.000992		-0.0000100
F-test for Restrictions:			1.5192 [16, 587]
Prob from F-test:			0.0870

Notes: The numbers within the parentheses are the t ratios. The numbers within the brackets are the degrees of freedom.

Table 4.2.2.--Second F-test For the Restriction of OLS Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	-0.33744	(-0.042)	-0.42672	(-0.057)
ACT	-0.43338	(-2.460)	-0.57831	(-4.087)
AGE	1.7271	(2.352)	1.6467	(2.277)
CMAJOR	0.17184	(2.772)	0.17571	(2.868)
COOPERAT	0.14947	(1.206)	-----	
DEVELOP	0.03749	(1.099)	-----	
EXTRAC	0.15172	(12.067)	0.14829	(12.214)
FAIL	0.29758	(7.527)	0.30595	(8.073)
GPA	-2.0656	(-1.555)	-0.38749	(-2.526)
GOSUMMER	0.02987	(0.261)	0.17282	(4.118)
STOPSEME	0.42930	(9.152)	0.42113	(9.389)
WITHDRAW	0.18913	(3.863)	0.18457	(3.810)
BLACK	-0.16355	(-0.884)	-----	
BS	0.03285	(0.304)	-----	
DGETFIN	-0.39192	(-3.434)	-0.38516	(-3.397)
DMINOR	0.86097	(5.654)	0.84164	(5.878)
DNOMAJOR	0.44316	(1.208)	-----	
MILITARY	-0.37522	(-0.428)	-----	
OTHERACE	-0.51113	(-0.919)	-----	
SEX	-0.23552	(-0.217)	-----	
TN	-0.13446	(-0.965)	-----	
ACTSQ	0.00942	(2.392)	0.01256	(3.792)
AGESQ	-0.04328	(-2.364)	-0.04117	(-2.282)
EXTRSQ	-0.00085	(-3.987)	-0.00082	(-3.932)
FAILSQ	-0.00420	(-1.865)	-0.00392	(-1.778)
GPASQ	0.28161	(1.264)	-----	
GOSSQ	0.03538	(1.300)	-----	
STOPSQ	-0.01384	(-6.209)	-0.01347	(-6.176)
Observation: 631				
R-squared:	0.7159		0.7114	
Adjusted R-squared:	0.7032		0.7039	
F-test for regression:	56.28 [27, 603]		94.61 [16, 614]	
Prob of F-test:	0.00000		0.00000	
Log-likelihood:	-0.0000100		-0.0000101	
F-test for Restrictions:			0.8627 [11, 603]	
Prob from F-test:			0.5779	

Notes: The numbers within in the parentheses are the t ratios. The numbers within the brackets are the degrees of freedom.

Table 4.2.3.--Preferred OLS Model, Standardized Coefficients, and Associated Marginal Effects and Elasticities

VARIABLE	PREFERRED	MARG.	ST1[1]	ST2[2]	ELASTIC.
Constant	-0.42672	-0.42672	10.778	10.778	
	(-0.055)	(-0.055)	(225.99)	(225.99)	
ACT	-0.57831	-0.05228	-1.8920	-0.13002	-0.10153
	(-3.671)	(-2.872)	(-3.671)	(-2.248)	(-2.872)
AGE	1.6467	0.12465	1.2006	-0.00388	0.21378
	(2.210)	(1.146)	(2.210)	(-0.055)	(1.146)
CMAJOR	0.17571	0.17571	0.14244	0.14244	0.00612
	(2.276)	(2.276)	(2.276)	(2.276)	(2.276)
EXTRAC	0.14829	0.14154	1.1262	0.78256	0.05428
	(11.552)	(12.109)	(11.552)	(17.385)	(12.109)
FAIL	0.30595	0.28991	1.0120	0.81396	0.05508
	(6.623)	(7.721)	(6.623)	(8.342)	(7.721)
GPA	-0.38749	-0.38749	-0.17793	-0.17793	-0.10217
	(-2.314)	(-2.314)	(-2.314)	(-2.314)	(-2.314)
GOSUMMER	0.17282	0.17282	0.21581	0.21581	0.02871
	(3.692)	(3.692)	(3.692)	(3.692)	(3.692)
STOPSEME	0.42113	0.39846	1.2020	0.44364	0.03111
	(6.886)	(6.984)	(6.886)	(4.169)	(6.984)
WITHDRAW	0.18457	0.18457	0.20109	0.20109	0.00950
	(3.345)	(3.345)	(3.345)	(3.345)	(3.345)
DGETFIN	-0.38516	-0.38516	-0.17226	-0.17226	
	(-3.775)	(-3.775)	(-3.775)	(-3.775)	
DMINOR	0.84164	0.84164	0.31841	0.31841	
	(6.585)	(6.585)	(6.585)	(6.585)	
ACTSQ	0.01256		1.7620		
	(3.458)		(3.458)		
AGESQ	-0.04117		-1.2045		
	(-2.212)		(-2.212)		
EXTRSQ	-0.00082		-0.34363		
	(-5.432)		(-5.432)		
FAILSQ	-0.00392		-0.19802		
	(-1.350)		(-1.350)		
STOPSQ	-0.00135		-0.75832		
	(-4.397)		(-4.397)		

Observation: 631
R-squared: 0.7114
Adjusted R-squared: 0.7039
F-test for regression: 94.61 [16, 614]
Log-likelihood: -0.0000101

Table 4.2.3.--Continued

VARIABLE	PREFERRED	MARG.	ST1[1]	ST2[2]	ELASTIC.

Breusch-Pagan Chi-squared: 288.171 [16]
Condition Number: 26.8 (without squared variable), 276.0 (with squared variable)

Notes: The numbers within the parentheses are the asymptotic t ratios. The numbers within the brackets are the degrees of freedom. [1] The ST1 column contains the standardized coefficients. [2] The ST2 column contains the formatted standardized coefficients, obtained by adding the first and second power standard coefficients. Breusch-Pagan Chi-squared is the Lagrange multiplier test for heteroscedasticity (Greene 1990, 421). The variance covariance matrix of the OLS estimate is adjusted as a heteroscedasticity consistent estimate (Kennedy 1987). Condition Number is a test for multicollinearity (Belsley and Kuh 1986).

Table 4.2.4.--First Wald Test For Restriction of Lognormal Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	0.55260	(0.069)	9.8128	(10.232)
ACT	-0.33320	(-2.069)	-0.01575	(-0.875)
AGE	1.5347	(2.038)	-0.00981	(-0.226)
CMAJOR	0.14869	(3.032)	0.16490	(3.367)
COOPERAT	0.25258	(2.229)	0.28006	(2.482)
DEVELOP	0.07325	(2.310)	0.10387	(3.779)
EXTRAC	0.14374	(7.921)	0.11713	(16.022)
FAIL	0.26984	(7.189)	0.26845	(14.827)
GPA	-1.8305	(-1.523)	-0.32816	(-2.627)
GOSUMMER	0.10641	(1.006)	0.17185	(4.339)
STOPSEME	0.42437	(9.451)	0.40837	(9.729)
WITHDRAW	0.18243	(3.450)	0.17238	(3.310)
BLACK	-0.07305	(-0.340)	-----	
BS	0.03541	(0.358)	-----	
DGETFIN	-0.40412	(-3.865)	-0.39368	(-3.725)
DMINOR	0.75475	(5.361)	0.76246	(5.612)
DNOMAJOR	-0.01148	(-0.040)	-----	
MILITARY	-0.41041	(0.293)	-----	
OTHERACE	-0.21811	(-0.242)	-----	
SEX	-0.01867	(-0.183)	-----	
TN	-0.12219	(-0.913)	-----	
ACTSQ	0.00712	(1.957)	-----	
AGESQ	-0.03977	(-2.100)	-----	
EXTRSQ	-0.00077	(-1.142)	-----	
FAILSQ	-0.00154	(-0.643)	-----	
GPASQ	0.24951	(1.209)	-----	
GOSSQ	0.01977	(0.802)	-----	
STOPSQ	-0.01367	(-5.640)	-0.01316	(-5.595)
å	0.10002	(38.059)	0.10181	(39.766)
Observation: 631				
Log-Liklihood:	559.0325		547.8726	
Wald Test for Restriction:			15.7463[13]	
Prob from Wald Test:			0.26310	

Notes: The numbers within the parentheses are the asymptotic t ratios. The number within the brackets is the degree of freedom.

Table 4.2.5.--Second Wald Test For Restriction of Lognormal Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	9.8128	(10.232)	9.4137	(23.941)
ACT	-0.01575	(-0.875)	-----	
AGE	-0.00981	(-0.226)	-----	
CMAJOR	0.16490	(3.367)	0.16106	(3.286)
COOPERAT	0.28006	(2.482)	0.26696	(2.395)
DEVELOP	0.10387	(3.779)	0.11718	(4.948)
EXTRAC	0.11713	(16.022)	0.11740	(16.423)
FAIL	0.26845	(14.827)	0.26540	(14.933)
GPA	-0.32816	(-2.627)	-0.36692	(-3.215)
GOSUMMER	0.17185	(4.339)	0.17236	(4.373)
STOPSEME	0.40837	(9.729)	0.41069	(10.054)
WITHDRAW	0.17238	(3.310)	0.17115	(3.300)
DGETFIN	-0.39368	(-3.725)	-0.40039	(-3.784)
DMINOR	0.76246	(5.612)	0.74741	(5.494)
STOPSQ	-0.01315	(-5.595)	-0.01321	(-5.677)
à	0.10181	(39.766)	0.10187	(39.775)
Observation: 631				
Log-Liklihood:	547.8726		547.5349	
Wald Test for Restriction:			0.7682[2]	
Prob from Wald Test:			0.68107	

Notes: The numbers within the parentheses are the asymptotic t ratios. The number within the bracket is the degree of freedom.

Table 4.2.6.--Preferred Lognormal Model, Standardized Coefficients, and Associated Marginal Effects and Elasticities

VARIABLE	PREFERRED	MARG.	ST1[1]	ST2[2]	ELASTIC.
Constant	9.4137	9.4137	10.777	10.777	
	(23.941)	(23.941)	(229.32)	(229.32)	
CMAJOR	0.16106	0.16106	0.13063	0.13063	0.005613
	(3.286)	(3.286)	(3.288)	(3.288)	(3.286)
COOPERAT	0.26696	0.26696	0.10876	0.10876	0.001452
	(2.395)	(2.395)	(2.393)	(2.393)	(2.395)
DEVELOP	0.11718	0.11718	0.26296	0.26296	0.014903
	(4.948)	(4.948)	(4.944)	(4.944)	(4.948)
EXTRAC	0.11740	0.11740	0.89142	0.89142	0.045021
	(16.423)	(16.423)	(16.419)	(16.419)	(16.423)
FAIL	0.26540	0.26540	0.87771	0.87771	0.050419
	(14.933)	(14.933)	(14.931)	(14.931)	(14.933)
GPA	-0.36692	-0.36692	-0.16872	-0.16872	-0.096748
	(-3.215)	(-3.215)	(-3.220)	(-3.220)	(-3.215)
GOSUMMER	0.17236	0.17236	0.21523	0.21523	0.028639
	(4.373)	(4.373)	(4.373)	(4.373)	(4.373)
STOPSEME	0.41069	0.38846	1.1722	0.42855	0.030330
	(10.054)	(10.407)	(10.055)	(4.377)	(10.407)
WITHDRAW	0.17115	0.17115	0.18644	0.18644	0.008808
	(3.300)	(3.300)	(3.300)	(3.300)	(3.300)
DGETFIN	-0.40039	-0.40039	-0.17902	-0.17902	
	(-3.784)	(-3.784)	(-3.783)	(-3.783)	
DMINOR	0.74741	0.74741	0.28284	0.28284	
	(5.494)	(5.494)	(5.496)	(5.496)	
STOPSQ	-0.01321		-0.74365		
	(-5.677)		(-5.678)		
å	0.10187		0.10186	0.10186	
	(39.775)		(39.779)	(39.779)	

Observation: 631
Log-Liklihood: 547.53 49

Notes: The numbers within the parentheses are the asymptotic t ratios. [1] The ST1 column contains the standardized coefficients. [2] The ST2 column contains the formatted standardized coefficients, obtained by adding the first and second power standard coefficients.

Table 4.2.7.--First Wald Test For Restriction of Poisson Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	2.7537	(1.979)	2.9445	(11.928)
ACT	-0.029393	(-0.974)	-0.0009378	(-0.248)
AGE	0.076354	(0.600)	0.001125	(0.096)
CMAJOR	0.014467	(0.562)	0.013583	(1.270)
COOPERAT	0.019887	(0.936)	0.020284	(0.972)
DEVELOP	0.0063390	(1.092)	0.0087387	(1.747)
EXTRAC	0.012247	(5.763)	0.012077	(5.867)
FAIL	0.029319	(4.128)	0.030808	(4.788)
GPA	-0.19580	(-0.831)	-0.036248	(-1.320)
GOSUMMER	0.018658	(0.922)	0.014974	(2.018)
STOPSEME	0.027509	(3.559)	0.026548	(3.668)
WITHDRAW	0.015980	(1.061)	0.014893	(1.835)
BLACK	-0.010145	(-0.313)	-----	
BS	0.0070664	(0.367)	-----	
DGETFIN	-0.040546	(-1.949)	-0.039834	(-1.929)
DMINOR	0.070840	(2.542)	0.074050	(2.830)
DNOMAJOR	0.019046	(0.299)	-----	
MILITARY	-0.025347	(-0.165)	-----	
OTHERACE	-0.016502	(-0.169)	-----	
SEX	0.004173	(0.215)	-----	
TN	-0.018349	(-0.743)	-----	
ACTSQ	0.00064593	(0.952)	-----	
AGESQ	-0.0019254	(-0.608)	-----	
EXTRSQ	-0.00008364	(-2.433)	-0.00008005	(-2.381)
FAILSQ	-0.0010479	(-2.492)	-0.0010935	(-3.074)
GPASQ	0.026460	(0.666)	-----	
GOSSQ	-0.00069262	(-0.148)	-----	
STOPSQ	-0.0010186	(-2.766)	-0.0010080	(-2.830)
CMAJSQ	-0.00069674	(-0.091)	-----	
WITHSQ	-0.00008939	(-0.038)	-----	
Observation: 631				
Log-likelihood:	-1605.1		-1606.6	
Restricted Log-l:	-1744.5		-1744.5	
LR statistic:	278.8		275.7	
Chi-squared:	125.34		128.6	
G-squared:	123.72		126.8	
Wald test for Restrictions:			3.0822 [13]	
Prob from Wald test:			0.9976	

Notes: The numbers within the parentheses are the asymptotic t ratios. The number within the brackets is the degree of freedom. Chi-squared and G-squared are two goodness of fit statistics (Agresti 1987).

Table 4.2.8.--Second Wald Test For Restriction of Poisson Model

VARIABLE	UNRESTRICTED MODEL		RESTRICTED MODEL	
Constant	2.9445	(11.928)	2.8320	(99.088)
ACT	-0.0009378	(-0.248)	-----	
AGE	0.001125	(0.096)	-----	
CMAJOR	0.013583	(1.270)	-----	
COOPERAT	0.020284	(0.972)	-----	
DEVELOP	0.0087387	(1.747)	0.010463	(2.697)
EXTRAC	0.012077	(5.867)	0.012056	(5.893)
FAIL	0.030808	(4.788)	0.035460	(6.493)
GPA	-0.036248	(-1.320)	-----	
GOSUMMER	0.014974	(2.018)	0.016631	(2.301)
STOPSEME	0.026548	(3.668)	0.026851	(3.724)
WITHDRAW	0.014893	(1.835)	0.015560	(1.932)
DGETFIN	-0.039834	(-1.929)	-0.046108	(-2.273)
DMINOR	0.074050	(2.830)	0.082195	(3.229)
STOPSQ	-0.0010080	(-2.830)	-0.0010264	(-2.892)
EXTRSQ	-0.00008005	(-2.381)	-0.00008241	(-2.469)
FAILSQ	-0.0010935	(-3.074)	-0.0012819	(-3.834)
Observation: 631				
Log-likelihood:	-1606.6		-1608.8	
Restricted Log-l:	-1744.5		-1744.5	
LR Statistic:	275.7		271.4	
Chi-squared:	128.6		133.2	
G-squared:	126.8		131.1	
Wald Test for Restrictions:			4.3421 [5]	
Prob from Wald Test:			0.5013	
Prob from Cameron-Trivedi Test:			0.0000	

Notes: The numbers within the parentheses are the asymptotic t ratios. The number within the brackets is the degree of freedom. Chi-squared and G-squared are two goodness of fit statistics (Agresti 1987). Cameron and Trivedi test is used for testing over- or underdispersion in the Poisson regression model(Cameron and Trivedi 1990).

The Comparison Among OLS, Lognormal and Poisson Model

A specific goodness of fit measurement like R-squared for OLS or G-squared for the Poisson model is useful for selection of regressors in the same type of models. It is not very meaningful to use them when we compare different types of models. Maddala suggests that we can use a predicted residual sum of squares (PRESS) as a criterion to compare different types of regression (1992, 482) models.

This procedure requires us to split the data into two parts: one for estimation and the other for prediction. This is called cross-validation. We estimate the models using the first part of the data and then use the estimated parameters to generate predictions for the second part of the data. The model that minimizes the PRESS is then chosen as the best model.

$$PRESS = \sum\left(\mu_i^*\right)^2$$

$$\mu_i^* = y_i - \hat{y}(i)$$

μ_i^* : the predicted residuals.

y_i : actual value of dependent variable in part two.

$\hat{y}(i)$: prediction of y_i from a regression equation that is estimated from the first part of the data.

Another criterion used to compare the different type of regression models is a count R-squared (Maddala 1992, 334).

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

Like the PRESS criterion, the data is split into two parts: one for estimation and the other for out-of-sample prediction. The model that maximizes the count R-squared is then chosen as the best model.

In this study, the author splits the data into two parts. The first part which includes 600 observations is used for estimating the parameters. The second part which includes 31 observations is used for out-of-sample prediction. All the actual values of the dependent variable (y_i) and its predicted values ($\hat{y}(i)$) are rounded to integers (exact number of semesters). The dependent variable in the Poisson model is censored at 15.

The PRESS is calculated for the OLS, Lognormal, and Poisson models. Since the total number of observations is the same for all models (31), this study will count the number of correct predictions instead of count R-squared.

This procedure is repeated 1,000 times by splitting the data into two parts randomly. The frequency of the PRESS and the number of correct predictions for the three models are plotted in Figure 2 and 3.

From both figures, we can see that there is no major difference in prediction among these three models. The Poisson model has a slightly higher number of correct predictions. On average, the Poisson model can correctly predict one more observation than the OLS and Lognormal models. The OLS and Lognormal models are nearly identical concerning the number of correct predictions. Table 4.3.1 lists the means and variances of the frequency of correct predictions for these three models.

Table 4.3.1.--Means and Variances of the Frequency of Correct Predictions

	OLS	LOGNORMAL	POISSON
Means	11.347	11.097	12.466
Variances	7.078591	7.183591	7.482844

In figure 3, although the frequency distributions for the PRESS values of the three models are very similar, the predicted residuals among these models are different. The Poisson model has the smallest mean and variance of the predicted residuals. The OLS model has the highest predicted residuals on average and the variance of the predicted residuals is very high. Table 4.3.2 lists the means and variances of PRESS for the three models.

Table 4.3.2.--Means and Variances of the Frequency of PRESS

PRESS	OLS	LOGNORMAL	POISSON
Means	73.538	61.106	55.492
Variances	4285.363	689.7208	327.0019

From the above analysis, we can conclude that the Poisson model is the best model. The Poisson model also uses fewer independent variables. Although the OLS model is not very good compared with the Poisson model, the OLS model has strong predictive power. Also, it is simple and very straightforward and easily explained. By using the Lognormal model, we can improve the results from the OLS model.

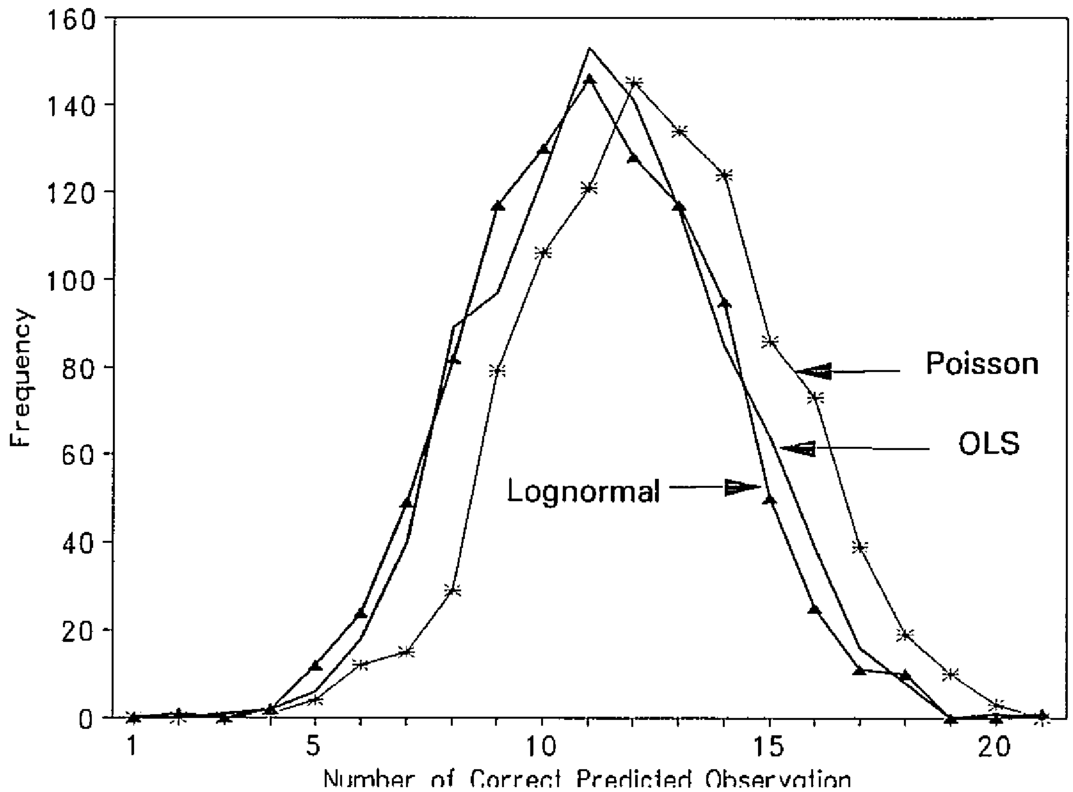

Figure 2. Comparison of the Correct Prediction Among OLS, Lognormal, and Poisson Models. The X-axis is the number of correctly predicted observations in 31 out-of-sample predictions. The Y-axis is the frequency of getting the specific correctly predicted number from the 1,000 Monte Carlo runs.

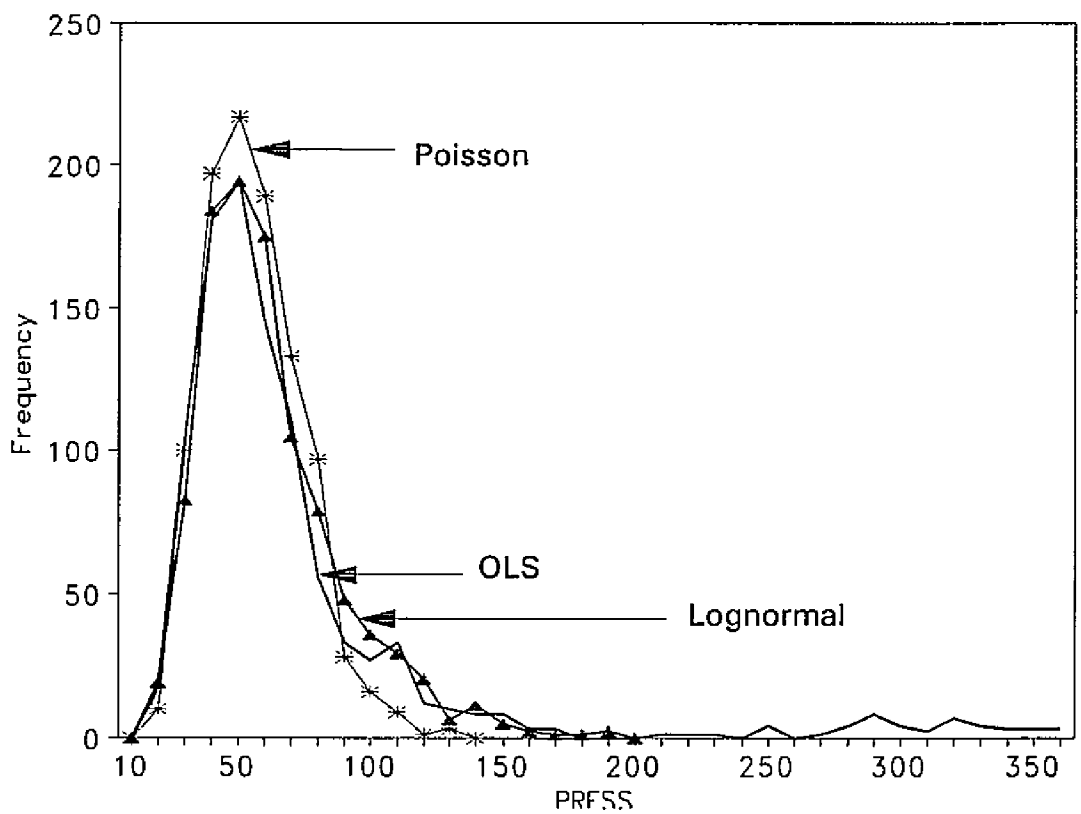

Figure 3. Comparison of PRESS Among OLS, Lognormal, and Poisson Models. The X-axis is PRESS of 31 out-of-sample predictions. The Y-axis is the frequency of getting specific PRESS from the 1,000 Monte Carlo runs.

The Analysis of The Variables

In Table 4.2.3 and 4.2.6, the author calculated the marginal effect, standardized coefficient, and associated elasticity for the OLS and Lognormal models.

The independent variables included in the three models are quite similar. In all three models the coefficient of the variables BLACK, OTHERACE, SEX, MILITARY, TN, BS, and DNOMAJOR are not significant. These results suggest some surprising conclusions.

Contrary to previous studies (Chann 1987; William 1990; Dillon 1990; Knight 1990; Grosset 1991; Spinetta 1991), the ethnicity background (BLACK and OTHERACE) is not associated with degree completion time. The unexpected result may be attributed to the outstanding performance of black students at MTSU. One point that must be noted is the small proportion of minority graduates in this study (8.6 percent).

This study yields a negative answer to the issue of whether gender (SEX) plays a role in the degree completion time. This finding concurs with the earlier studies. Most of these studies suggest that there are no major differences in the degree completion time between the genders (Chann 1987; Crawford 1989; and etc.). Evidently, military service (MILITARY) is not a very useful factor in this study since only two students are veterans.

The results of testing the influence from hometown location (TN) also contradicts common belief and Chann's study (1987). There is no difference in the degree completion time between the in-state and out-of-state students. The hypothesis can be tested in more detail only if we can find some more specific variable concerning hometown location, such as the distance from the hometown to MTSU.

This study reveals that there is no significant difference in the degree completion time between the students with degrees in science and degrees in non-science. The coefficient of the DNOMAJOR indicates that it will not delay graduation if a student did not decide his or her major the first semester of college life.

The age factor (AGE) is insignificant for the delay of graduation in the Lognormal and the Poisson model. The OLS model also suggests that the marginal effect from AGE is not significant. In Figure 5, the author plotted the marginal effect of age across AGE (refer to Figure 5). We can see that the confidence interval ($\alpha = 0.05$) includes the zero for all age. Although the elasticity is quite high and significant, the percent change in age will not change much in this sample. So we can say that age is not important for the degree completion time. This is in agreement with the prior research which shows that the delay of entrance into college has no influence on the degree completion time (Hill

1986, Knepper 1989).

Course failure (FAIL) is one of the strongest factors that cause the delay of graduation as suggested by both standardized coefficients of the OLS and the Lognormal model. The Poisson model also proved that there is a significant relationship between course failure and the degree completion time. This is contradicts the University of California survey study, which suggested only 7 percent of students have this influence. The coefficients, standardized coefficients, and elasticities from both models are close. The results mean that every course failed will cause 0.27 and 0.29 semester delay as suggested by the Lognormal model and the OLS model respectively. By plotting out the marginal effect across the number of course failures, we can find that the first several course failures will cause more delay of graduation than the effect from later course failures (refer to Figure 7).

Another strong factor that contributes to the degree completion time is EXTRAC as indicated by all three models. The variable EXTRAC used in this study does not include the extra credit caused by developmental courses, failed courses, changing majors, and study for minor. Therefore EXTRAC most likely represents that the credits were taken out of interest or entertainment. The conclusion is supported by previous studies (Grosset 1990; Spinetta 1991). From figure 6, we can see the early extra courses have a stronger effect on the delay of graduation (refer to Figure 6).

The third factor which influences the degree completion time in the three models is the STOPSEME. From this study we can find the stopout behavior not only increases the time span from entrance to graduation but also it increases the actual enrollment time in the college. Every semester stopout will cause an extra 0.39 and 0.40 semester delay suggested by Lognormal and OLS model respectively. This opposes Grosset's study which suggests that stopout will not significantly increase delay (1991). Actually, the first semester stopout will cause more delay of graduation than later stopout (refer to Figure 8).

DMINOR is the most important dummy variable in all three models. It suggests that choosing a minor will significantly increase the time to graduation. The OLS and the Lognormal models propose that every minor will delay graduation by 0.74 and 0.84 semesters respectively. The result from the treatment effect analysis suggests that the effect from the academic minor is underestimated (refer to Table A.1). This means students who have minors usually can finish their major requirements more quickly. The academic minor actually takes about 1 semester as suggested from the treatment effect analysis.

Another significant dummy variable is DGETFIN. Like the earlier studies and surveys (Grosset 1991 and etc.), all three models in this study have shown a significant relationship between financial aid and degree completion time. Getting financial aid will shorten graduation about 0.4 semesters as suggested by the OLS and the Lognormal models. Again, by applying the treatment effect analysis, this study finds the effect from financial aid on the degree completion time is underestimated by the OLS and the Lognormal models (refer to Table A.2). This is because students who receive financial aid usually would have taken more time to finish their degree if they had not received financial aid. The analysis of treatment effect suggests financial aid shortens the degree completion time by about 1.2 semester. But this result is not very significant according to the analysis.

Surprisingly, the WITHDRAW has a strong influence on the degree completion time. Every course withdrawal will cause 0.17 or 0.19 semester delay according to the Lognormal and the OLS models respectively. They are approximate the amount of time spent in a course.

It is interesting to measure the effect of going to summer school (GOSUMMER). Going to summer school is obviously very important to our degree completion time. In this study, every summer school semester is counted as a half semester when we calculate the total semesters that a student spent on the bachelor's degree. The positive sign of the coefficient in the OLS and the Lognormal models suggest the effect of attending summer school is less than a half semester. On average, every summer semester is equal to 0.33 (0.5-0.17) semesters as implied by the OLS and the Lognormal models.

The OLS and the Lognormal models confirm that the graduate grade point average (GPA) is negatively related to the degree completion time. This result affirms the former studies (Chann 1987; Grosset 1991; and etc.); better students can finish their degree more quickly. A one percent increase in the graduate grade point average will decrease the degree completion time by 0.1 percent.

Except in the Poisson model, the effect of a change in major (CMAJOR) is very important as the prior studies show and as expected. Each time that students change their majors their graduation will be delayed by 0.16 or 0.18 according to the Lognormal and the OLS model respectively.

Developmental courses (DEVELOP) are significantly related to the degree completion time in the Lognormal and the Poisson model. According to the Lognormal model, every developmental course will cause one quarter of a semester delay in graduation. This time is close to the time spent on the developmental course itself. The result implies that after the developmental course, the "under-prepared" students can finish the degree course work in the same time range as the "prepared" students. This finding agrees with the survey conducted at University of California system(1986).

With regard to the effect of the ACT score (ACT), only the OLS model appears to show a negative relationship between the ACT score and the degree completion time. Although the significance level of the relationship between the ACT score and the dependent variable is quite high, the actual effect of the ACT score on the degree completion time is not very important. Each point increase in the ACT score will shorten the degree completion time by 0.05 semester. This result is similar to Chann's study, which suggests that the subgroups of the ACT score instead of the composite ACT score is significantly associated with the degree completion time. The plot of marginal effect across the ACT is very interesting (refer to Figure 4). It suggests that ACT scores are very important factor to the delay of graduation for the lower ACT scores students. In other words, one point increase in the ACT scores for the lower score students will shorten the degree completion time much more than that for high score students. The ACT score becomes not important to the degree completion time when it reaches 22 points. The increase in ACT scores for the very high score students (above 27 points) will even delay graduation.

The Lognormal model also reveals that the cooperative course (COOPERAT) will delay a student's graduation. But the OLS and the Poisson model suggest that it is not an important factor. The inconsistent results may be caused by the small portion of students that took cooperative courses in this sample.

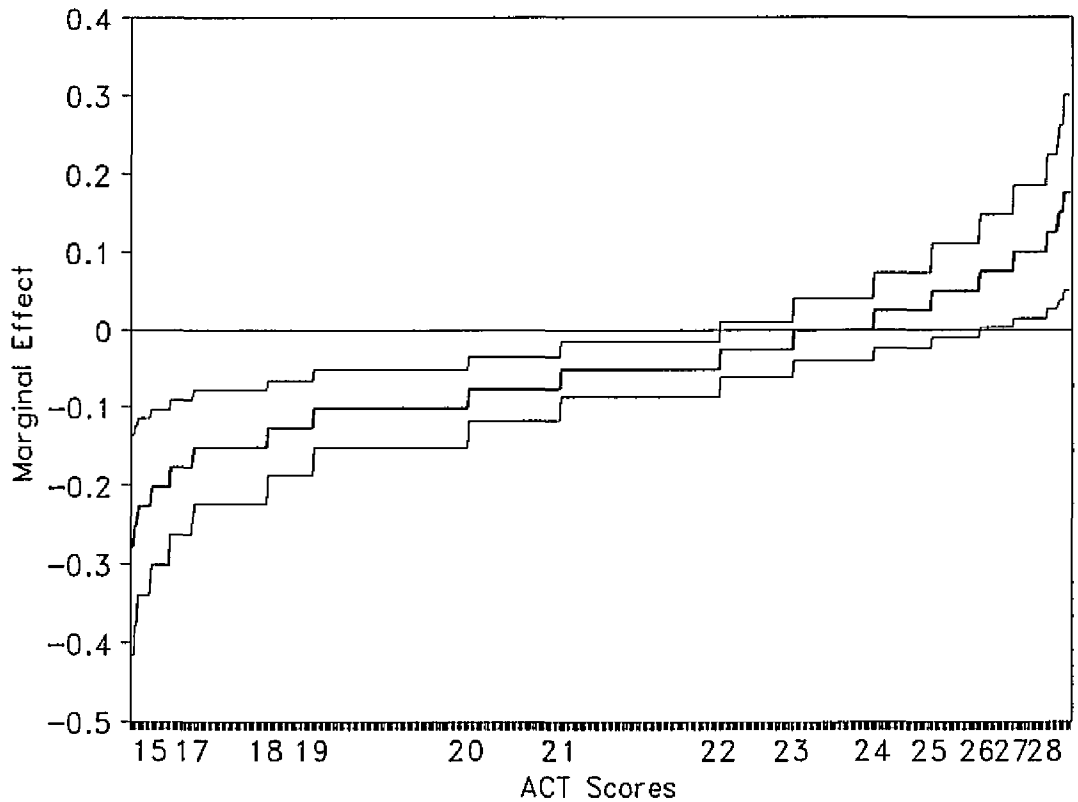

Figure 4. Marginal Effect of ACT with its Confidence Interval ($\alpha = 0.05$) for the OLS model. The X-axis is the ACT scores. The Y-axis is the marginal effect on degree completion time (number of semesters).

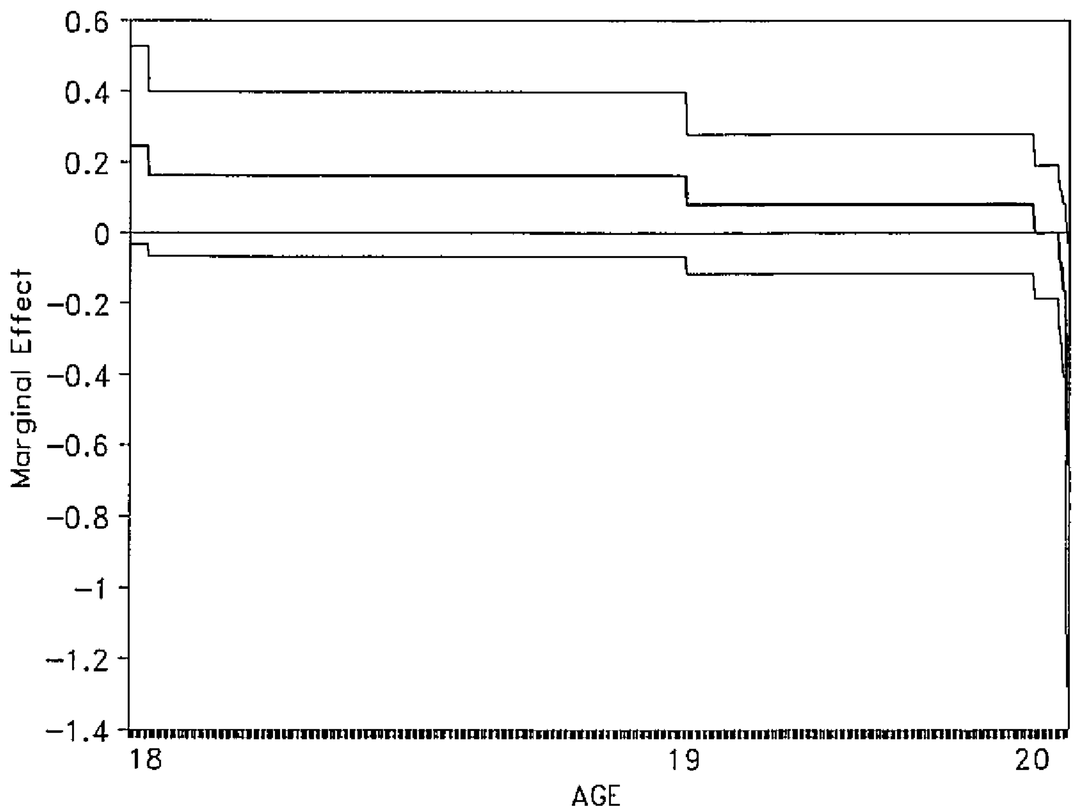

Figure 5. Marginal Effect of AGE with its Confidence Interval ($\alpha = 0.05$) for the OLS model. The X-axis is the age of students. The Y-axis is the marginal effect on degree completion time (number of semesters).

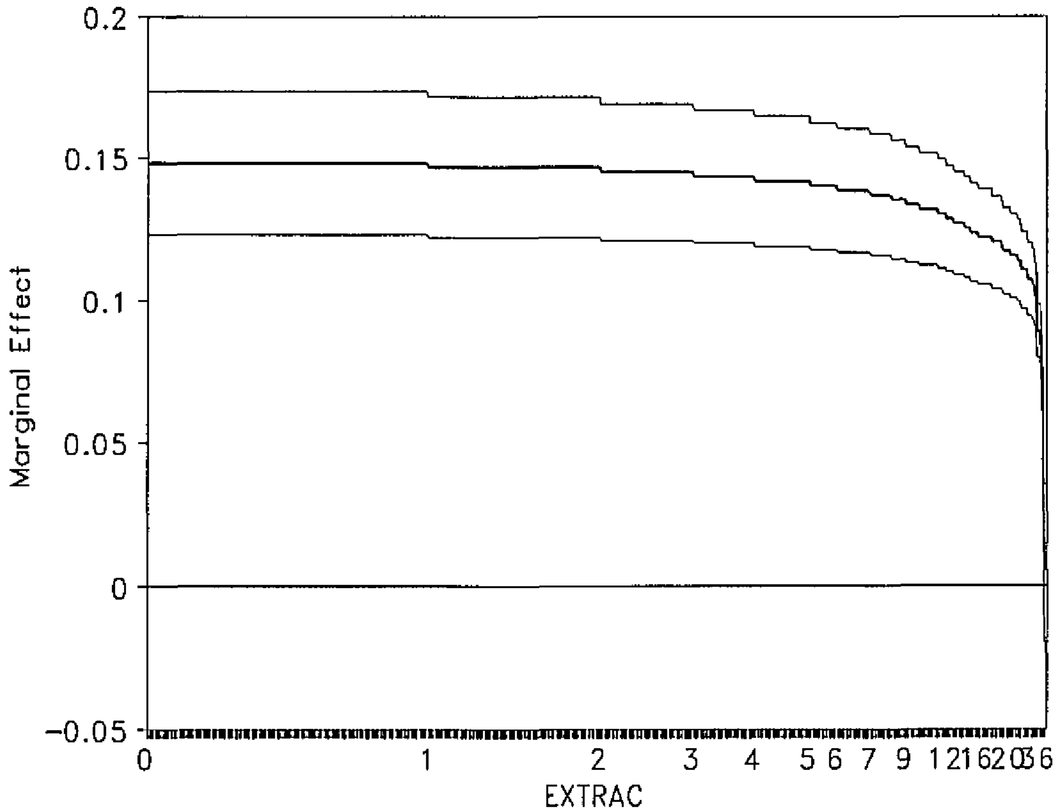

Figure 6. Marginal Effect of EXTRAC with its Confidence Interval ($\alpha = 0.05$) for the OLS model. The X-axis is EXTRAC. The Y-axis is the marginal effect on degree completion time (number of semesters).

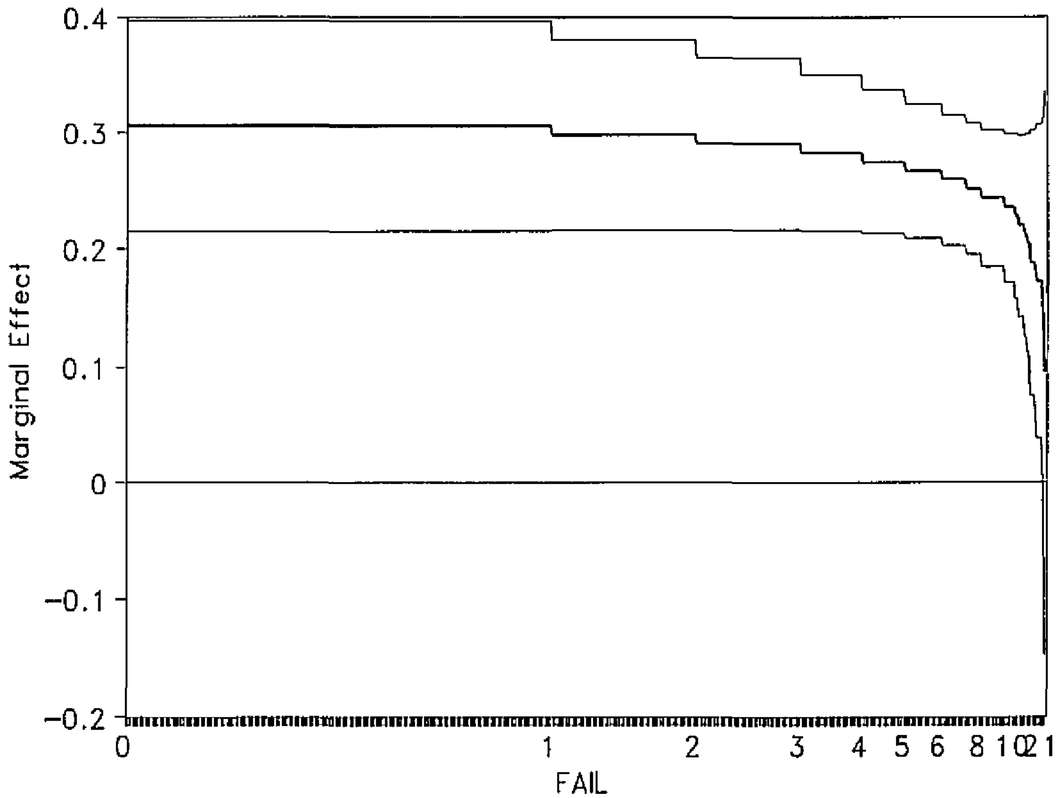

Figure 7. Marginal Effect of FAIL with its Confidence Interval ($\alpha=0.05$) for the OLS model. The X-axis is the number of courses failed. The Y-axis is the marginal effect on degree completion time (number of semesters).

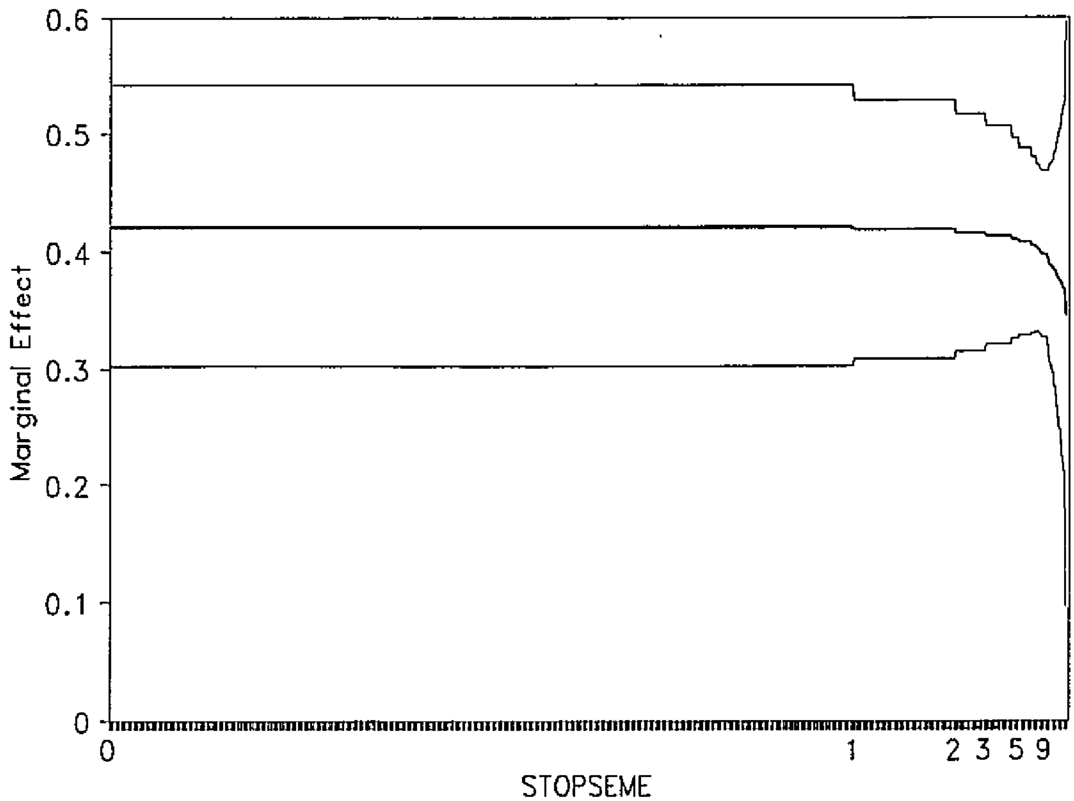

Figure 8. Marginal Effect of STOPSEME with its Confidence Interval ($\alpha = 0.05$) for the OLS model. The X-axis is the total stopout semesters of a student. The Y-axis is the marginal effect on degree completion time (number of semesters).

The Early Stage Prediction Model

This study is also interested in the early stage prediction models based on variables known in the earliest stage of college. If it is possible to build a model with the student's demographic, pre-college, and some early college relevant variables, the student's advisers can pay particular attention to the student with a high possibility of graduation delay from the outset of his or her college life. But the results are not satisfactory compared to the full explanatory models discussed above. The sequences of restriction tests to build the preferred early stage prediction model are presented in Appendix C.

We can compare the early stage models with the full explanatory models by using Theil's $\overline{R}^2$ (Maddala 1992). That is choosing the model with the minimum $\hat{\sigma}_j^2$:

$$\hat{\sigma}_j^2 = \frac{RSS_j}{n-k_j}$$

where RSS_j is the residual sum of squares from the jth model with k_j explanatory variables, n is the total observations.

Table 4.5.1 displays the $\hat{\sigma}_j^2$ of early stage prediction models and full explanatory models. Evidently, the early stage prediction model lost a lot of information. This result is quite surprising to author and dissertation committee members. There are two possibilities. First, this means that the degree completion time is primarily attributable to the college relevant variables. Second, the variables included in the early stage prediction model fail to present the major information of the students pre-college status. It seems possible that the early stage prediction model will have more power if we can have detailed information from MTSU's SIS system on variables such as high school ranking and high school location.

Table 4.5.1.--The $\hat{\sigma}_j^2$ of Early Stage Prediction and Full Explanatory Models

MODEL	OLS	LOGNORMAL	POISSON
Early Stage Prediction Model	2.8325	2.8571	2.4148
Full Explanatory Model	1.5170	1.5983	1.2139

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The purpose of this study is to find determinants of completion time for a bachelor's degree. By applying multivariate regression analysis, this study tests the relationships between the potential factors and degree completion time. In general, the models fit well both in a explanatory and in a predictive sense.

The results from the OLS, the Lognormal, and the Poisson models are very similar. The Poisson model is the best model concerning prediction. The OLS and the Lognormal model are identical except that prediction from the Lognormal has smaller variance.

For the individual variables, the results suggest that the degree completion time is not related to ethnic background, gender, hometown location, degree type, military service and early declaration of a major. Age also is not an important factor for the degree completion time.

The delay of graduation is primarily attributable to the college relevant variables. These factors include failure in and withdrawal from some courses, recovery from stopping out, taking extra credit for personal interest, lack of financial aid, studying for a minor, and changing majors. The first few course failures and stopout semesters will cause more delay than the subsequent failures or stopout semesters.

Each time summer school is attended will decrease the degree completion time about 0.33 semester. A good student with a high GPA can finish his or her degree quickly. The OLS model also has found that students with low ACT scores are likely to delay their college graduation. Cooperative courses will cause some delay in graduation as suggested by the Lognormal model.

Although the developmental course will cost some time, it will prevent further delay for the unprepared student.

Conclusions and Implications

The major purpose of this degree completion time study is to help the administrators revise recruitment, assessment, and placement policies and practices. The findings in this study also provide several implications for the MTSU administrators and faculties:

1. The students need more advising since some of them waste their time in changing their major and course selection. University may wish to devote more resources to

freshman orientation, career counseling, peer advising, or other innovative methods of informing students of their options. It may decrease the unnecessary delay of graduation if students can visit their advisors before changing majors and selecting courses. The student's advisers need to pay more attention to the students who take minor, cooperative courses, or have low GPAs.

2. It is also important for the faculty to help those students likely to withdraw from or fail in their courses.

3. Financial aid still is a major determinant of degree completion time. The reduced federal loans and grant money will cause more students to work. It is very important for our administrators and student advisers to prevent student stopout due to work. Stopout delays the graduation much more than the stopout, itself especially the first few semesters' stopout.

4. Developmental courses are helpful in serving the needs of students who are under-prepared to enter the regular college curriculum. By spending time on achieving academic competence, the developmental courses can prevent the further delay of graduation.

5. In the present study, various lacunae in the data stored on MTSU SIS made it difficult to draw a complete picture of the factors affecting degree completion time. Of particular concern is the fact that two-thirds of the graduating students (mainly transfer) were excluded from the

investigation. Because of the SIS many shortcomings, it is a pressing matter to improve the student information system in MTSU. Following are some suggestions which emerge from this study:

First, the SIS system should collect more student pre-college information. Many colleges presently to use marketing strategies to attract their students. The pre-college factors are the most important information about a university's customers (the students). The university should record and maintain this information in the SIS system. The Pre-college factors beyond the ones used in this study can include high school ranking, high school location, student class ranking in their high school graduating class, ACT component scores, and some student family related factors such as hometown location, parents education background, occupation, and income, how many brothers or sisters, and whether students were brought up by their parents or not. Although the MTSU SIS has some of the items mentioned above, there are too many missing values for these items.

It is possible that the early stage prediction model could be improved if we can add these pre-college factors as independent variables.

Second, the SIS system should maintain the full records of the transfer students since they occupy almost two-third of our graduates. Data for transfer students on the MTSU

SIS fails to include even the pre-college data employed in this study. In addition most of the college relevant variables for transfer students are not reliable. Several studies on the developmental program conducted by MTSU doctoral candidates also excluded the transfer students due to missing data. The results concluded from the non-transfer students may be biased when applied to the entire student population at MTSU since the sample was not randomly selected.

Third, the student information system should develop some application packages to help faculty and administrators use the education research results. There have been many studies done in the fields of retention and attrition, developmental studies, course withdrawal, and degree completion time. These studies will become meaningless if we can not turn the research results into practical applications. It should be possible to develop software to identity the at-risk students by applying models from these studies.

Recommendations for Further Study

The recommendations for future study are based on the design and results of this study. As a follow-up to this study, several recommendations are made:

1. Since correcting the SIS shortcomings for transfer students may not be quickly forthcoming, further study on methodologies for approximating the missing data on transfer students is warranted.

2. It is probably timely for a consolidated review of all the findings from the internal studies on retention and attrition, developmental studies, course withdrawal, and degree completion time. This study can serve as the starting point for the development of application package noted above.

3. The replication of this study is recommended for other universities wishing to get a more general interpretation of the determinants of degree completion time. Also, replication of this study could be carried out every several years at MTSU to find the historic trends of the determinants of degree completion time.

4. In addition to the variables used in this study, some variables may be added. For example, if we can find the data of some specific variables for financial problems, such as the hours a student worked and family background, it is possible to explain the financial problem in more detail.

APPENDICES

APPENDIX A

GLOSSARY

GLOSSARY

Academic Assessment Placement Program (AAPP) exam: An examination for students who have a composite score of fifteen or lower on the ACT (eighteen on the enhanced ACT), fifteen or below on the English or Math portions of the ACT, or who are twenty-one years of age or older at the time of their admission. (MTSU Undergraduate Catalog, 1991-1993).

ACT: The American College Test, prepared by the American College Testing Services. This is a preliminary testing battery to generally determine applicability of the student for College level courses.

Attrition: An interchangeable word for withdrawal.

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

Course withdrawal: Assigned in courses which are dropped during the fifth through the eighth week of a term (MTSU Undergraduate Catalog 1991-1993).

Cooperative Course: In the Cooperative Education Program, the student performs a portion of his/her university education program as an employee in business, industry, government, or a service organization, where the work is directly related to his/her academic major (MTSU Undergraduate Catalog 1991-1993).

Dropout: An interchangeable word for withdrawal.

Developmental course: The program in developmental studies is designed to serve the needs of students who are under-prepared to enter the regular college curriculum. The purpose of the program is to assist students in achieving a level of academic competence that will enable them to work successfully in college-level courses. The developmental studies in four areas: writing skills, reading skills, mathematics skills, and study skills.

Early Stage Prediction Model: A regression model which only uses the demographic, pre-college, and some freshman year variables as regresses.

Full Explanatory Model: A regression model which uses the all demographic, pre-college, and college relevant variables as regresses.

Grade Point Average (GPA): At this study, a 4-point scale is used: 4 points for A grade; 3 points for B grade; 2 points for C grade; 1 point for D grade; and 0 points for F grade.

Non-Traditional Student: The non-traditional student is one who either first entered post-secondary education a year or more after high school, does not attend full time throughout the period of attendance, or does not complete a bachelor's degree in 4 years (Knepper 1989, 1)

Persistence: An antonym of withdrawal.

Retention: An interchangeable word for persistence.

Stopout: Students withdraw from college for a period and then come back to college.

Title IV Fund: A fund appropriated by the federal government to assist needy higher education students. The program includes grants, work-study, and loans.

Traditional Student: The traditional student is one who fully fits the mold by entering post-secondary education immediately after high school, is in attendance full time for 4 years and graduates with a bachelor's degree 4 years after high school (Knepper 1989, 1).

APPENDIX B

LIST OF VARIABLES

LIST OF VARIABLES

ACT : The student's ACT score.

AGE : The student's age when he or she first time enrolled in MTSU.

BLACK : Code 1 if the student's ethnic background is black and code 0 otherwise.

BS : Code 1 if the student has a bachelor in science and code 0 otherwise.

CMAJOR : Times the student changed his or her major.

COOPERAT : Total number of cooperative courses the student has taken.

DEVELOP : Total number of developmental courses the student has taken

DGETFIN : Code 1 if the student has received financial aid and code 0 otherwise.

DMINOR : Code 1 if the student has minor and code 0 otherwise.

DNOMAJOR : Code 1 if the student did not declare his or her major and code 0 otherwise.

EXTRAC : $EXTRAC = \frac{(total\ credits) - 132}{CMAJOR + DMINOR + 1}$

FAIL : Total failed courses of the student.

FANDS : Total spring and fall semesters the student has taken.

GOSUMMER : Total times the student attended summer school.

GPA	:	The graduate grade point average of the student.
HSGPA	:	High school grade point average of the student.
MILITARY	:	Code 1 if the student has military service and code 0 otherwise.
OTHERACE	:	Code 1 if the student's ethnic background is black or white and code 0 otherwise.
SEX	:	Code 1 if a male student and code 0 otherwise.
STOPSEME	:	Total spring and fall semesters the student did not consecutively register.
TN	:	Code 1 if the student's hometown is in Tennessee and code 0 otherwise.
TOTAL	:	Total semesters the student has enrolled at MTSU. The summer semester is counted as a half semester.
WITHDRAW	:	Total courses the student has withdrawn from.
ACTSQ	:	Squared ACT
AGESQ	:	Squared AGE
CMAJSQ	:	Squared CMAJOR
COOPSQ	:	Squared COOPERAT
DEVEDQ	:	Squared DEVELOP
EXTRSQ	:	Squared EXTRAC
FAILSQ	:	Squared FAIL
GPASQ	:	Squared GPA
GOSSQ	:	Squared GOSUMMER
STOPSQ	:	Squared STOPSEME

WITHSQ	:	Squared WITHDRAW
CMABLACK	:	Interaction term between CMAJOR and BLACK
CMASEX	:	Interaction term between CMAJOR and SEX
CMATN	:	Interaction term between CMAJOR and TN
GOSBLACK	:	Interaction term between GOSUMMER and BLACK
GOSSEX	:	Interaction term between GOSUMMER and SEX
GOSTN	:	Interaction term between GOSUMMER and TN
STOBLACK	:	Interaction term between STOPSEME and BLACK
STOSEX	:	Interaction term between STOPSEME and SEX
STOTN	:	Interaction term between STOPSEME and TN
WITBLACK	:	Interaction term between WITHDRAW and BLACK
WITSEX	:	Interaction term between WITHDRAW and SEX
WITTN	:	Interaction term between WITHDRAW and TN

APPENDIX C

ADDITIONAL TABLES

Table A.1.--Treatment Effect Analysis for DMINOR

VARIABLE	COEFFICIENT	T-RATIO
Constant	-0.31107	(-0.042)
ACT	-0.57153	(-4.087)
AGE	1.6062	(2.247)
CMAJOR	0.17711	(2.930)
EXTRAC	0.14865	(12.414)
FAIL	0.30557	(8.174)
GPA	-0.37245	(-2.440)
GOSUMMER	0.17593	(4.231)
STOPSEME	0.41959	(9.475)
WITHDRAW	0.18337	(3.835)
DGETFIN	-0.38566	(-3.450)
DMINOR	*1.0368*	*(3.482)*
ACTSQ	0.012344	(3.762)
AGESQ	-0.040060	(-2.245)
EXTRSQ	-0.00081890	(-4.002)
FAILSQ	-0.0039128	(-1.800)
STOPSQ	-0.013443	(-6.251)
LAMBDA	-0.13373	(-0.745)
Observation: 631		
R-sq:	0.7117	
Adj R-sq:	0.7037	
F-test:	89.01[17,613]	
Prob of F-test:	0.0000	

Notes: The numbers within the parentheses are the t ratios. The numbers within the brackets are the degrees of freedom.

Table A.2.--Treatment Effect Analysis for DGETFIN

VARIABLE	COEFFICIENT	T-RATIO
Constant	-0.47455	(-0.064)
ACT	-0.57002	(-4.061)
AGE	1.6464	(2.296)
CMAJOR	0.17558	(2.908)
EXTRAC	0.14795	(12.355)
FAIL	0.30546	(8.148)
GPA	-0.36624	(-2.384)
GOSUMMER	0.17365	(4.185)
STOPSEME	0.41630	(9.252)
WITHDRAW	0.18191	(3.782)
DGETFIN	*-1.2103*	*(-1.130)*
DMINOR	0.81644	(5.638)
ACTSQ	0.012736	(3.881)
AGESQ	-0.041180	(-2.303)
EXTRSQ	-0.0008141	(-3.977)
FAILSQ	-0.0039166	(-1.795)
STOPSQ	-0.013360	(-6.153)
LAMBDA	0.49235	(0.775)
Observation: 631		
R-sq:	0.7117	
Adj R-sq:	0.7037	
F-test:	89.03[17,613]	
Prob of F-test:	0.0000	

Notes: The numbers within the parentheses are the t ratios. The numbers within the brackets are the degrees of freedom.

Table A.3.--Early Stage Prediction OLS Model

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
Constant	155.11	158.25	162.04
	(4.020)	(4.409)	(2.761)
ACT	-0.61749	0.012208	-----
	(-2.068)	(0.348)	-----
AGE	-14.479	-15.754	-16.289
	(-3.486)	(-4.127)	(-2.580)
DEVELOP	0.043307	0.13469	0.16860
	(0.414)	(2.919)	(6.185)
HSGPA	-0.94948	-0.41789	-----
	(-0.593)	(-2.238)	-----
BLACK	3.4358	0.40076	-----
	(0.347)	(1.416)	-----
BS	-0.011069	-0.016091	-----
	(-0.067)	(-0.098)	-----
DGETFIN	-0.78311	-0.77096	-0.83883
	(-4.510)	(-4.509)	(-5.208)
DNOMAJOR	1.2009	1.5045	1.4833
	(2.163)	(2.763)	(1.321)
OTHERACE	-0.13421	-0.10980	-----
	(-0.137)	(-0.112)	-----
SEX	0.62563	0.39948	0.49339
	(0.115)	(2.390)	(3.092)
TN	-12.837	0.43640	0.47736
	(-1.736)	(1.955)	(1.884)
HSBLACK	-0.92942	-----	
	(-1.209)	-----	
HSSEX	-0.30687	-----	
	(-0.826)	-----	
HSTN	0.22613	-----	
	(0.519)	-----	
AGEBLACK	-0.17945	-----	
	(-0.351)	-----	
AGESEX	0.016457	-----	
	(0.059)	-----	
AGETN	0.53799	-----	
	(1.419)	-----	
ACTBLACK	0.16488	-----	
	(1.304)	-----	
ACTSEX	0.019293	-----	
	(0.331)	-----	
ACTTN	0.12193	-----	
	(1.658)	-----	

Table A.3.--Continued

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
ACTSQ	0.013277	-----	
	(1.969)	-----	
AGESQ	0.38476	0.42160	0.43617
	(3.495)	(4.162)	(2.570)
DEVESQ	0.005083	-----	
	(0.420)	-----	
HSGPSQ	0.11334	-----	
	(0.439)	-----	
Observation: 494			
R-sq:	0.2134	0.1908	0.1790
Adj R-sq:	0.1731	0.1706	0.1672
F-Test:	5.30[24,469]	9.448[12,481]	
9.546[7,486]			
Prob of F-test:	0.0000	0.0000	0.0000
Log-likelihood.:	-94.4	-95.10	95.46
F-test for Restrictions:		1.12[12, 469]	
1.40[5,481]			
Prob from F-test:		0.3388	0.2247

Notes: The numbers within the parentheses are t ratios. The numbers within the brackets are the degrees of freedom.

Table A.4.--Early Stage Prediction Lognormal Model

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
Constant	133.08	132.61	128.90
	(3.692)	(4.213)	(4.154)
ACT	-0.55697	0.013030	-----
	(-1.924)	(0.405)	-----
AGE	-12.302	-12.962	-----
	(-3.160)	(-3.895)	-----
DEVELOP	0.082917	0.15335	-----
	(0.712)	(2.803)	-----
HSGPA	-0.46811	-0.41855	-12.507
	(-0.332)	(-2.419)	(-3.826)
BLACK	2.5200	0.44534	0.14718
	(0.203)	(1.650)	(2.959)
BS	0.005088	-0.000957	-0.47264
	(0.032)	(-0.006)	(-3.103)
DGETFIN	-0.78443	-0.77919	-0.78578
	(-5.030)	(-5.032)	(-5.157)
DNOMAJOR	0.70527	1.0017	1.0334
	(1.919)	(3.332)	(3.365)
OTHERACE	-0.12212	-0.10518	-----
	(-0.108)	(-0.094)	-----
SEX	3.8807	0.33147	-----
	(0.755)	(2.034)	-----
TN	-11.237	0.38325	0.37789
	(-1.597)	(2.029)	(2.036)
HSBLACK	-1.1377	-----	
	(-1.292)	-----	
HSSEX	-0.26374	-----	
	(-0.751)	-----	
HSTN	0.16136	-----	
	(0.432)	-----	
AGEBLACK	-0.098209	-----	
	(-0.145)	-----	
AGESEX	-0.14828	-----	
	(-0.549)	-----	
AGETN	0.46265	-----	
	(1.266)	-----	
ACTBLACK	0.17133	-----	
	(0.859)	-----	
ACTSEX	0.000241	-----	
	(0.004)	-----	
ACTTN	0.11857	-----	
	(1.888)	-----	

Table A.4.--Continued

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
ACTSQ	0.012143	-----	
	(1.816)	-----	
AGESQ	0.32729	0.34560	0.33370
	(3.165)	(3.951)	(3.891)
DEVESQ	0.002891	-----	
	(0.174)	-----	
HSGPSQ	0.030311	-----	
	(0.136)	-----	
ȧ	0.14600	0.14790	0.14919
	(29.189)	(29.971)	(30.201)
Observation: 494			
Log-L.:	252.2	245.9	241.6
Wald Test for Restriction:		13.39[12]	8.530[5]
Prob from Wald Test:		0.3411	0.1294

Notes: The numbers within the parentheses are the asymptotic t ratios. The numbers within the brackets are the degrees of freedom. The variable MILITARY is not included in the unrestricted model because of singular problem.

Table A.5.--Early Stage Prediction Poisson Model

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
Constant	11.618	11.982	12.151
	(2.421)	(2.699)	(2.777)
ACT	-0.052634	0.00067082	-----
	(-1.395)	(0.146)	-----
AGE	-0.83629	-0.93719	-0.97127
	(-1.620)	(-1.989)	(-2.096)
DEVELOP	0.0088805	0.012967	0.017085
	(0.667)	(2.215)	(3.969)
HSGPA	-0.054703	-0.042701	-----
	(-0.265)	(-1.765)	-----
BLACK	0.32556	0.039914	-----
	(0.246)	(1.090)	-----
BS	-0.0025966	-0.0035779	-----
	(-0.120)	(-0.167)	-----
DGETFIN	-0.070760	-0.069383	-0.078868
	(-3.056)	(-3.048)	(-3.536)
DNOMAJOR	0.066102	0.089853	0.094387
	(0.944)	(1.317)	(1.392)
MILITARY	-0.085343	-0.066633	-----
	(-0.361)	(-0.298)	-----
OTHERACE	-0.009870	-0.011537	-----
	(-0.074)	(-0.087)	-----
SEX	0.51519	0.034158	-----
	(0.744)	(1.568)	-----
TN	-0.82908	0.038334	-----
	(-0.876)	(1.329)	-----
HSBLACK	-0.078090	-----	
	(-0.803)	-----	
HSSEX	-0.025707	-----	
	(-0.533)	-----	
HSTN	0.023690	-----	
	(0.424)	-----	
AGEBLACK	-0.019017	-----	
	(-0.278)	-----	
AGESEX	-0.021543	-----	
	(-0.610)	-----	
AGETN	0.032871	-----	
	(0.676)	-----	
ACTBLACK	0.016176	-----	
	(1.017)	-----	
ACTSEX	-0.0001896	-----	
	(-0.025)	-----	

Table A.5.--Continued

VARIABLE	UNRESTRICTED	RESTRICTED	PREFERRED
ACTTN	0.0087277	-----	
	(0.929)	-----	
ACTSQ	0.0011576	-----	
	(1.352)	-----	
AGESQ	0.022140	0.024768	0.025817
	(1.622)	(1.985)	(2.105)
DEVESQ	-0.00001022	-----	
	(-0.007)	-----	
HSGPSQ	0.0037026	-----	
	(0.111)	-----	
Observation: 494			
Log-likelihood:	-1303.5	-1306.3	-1311.8
Restricted Log-l:	-1331.3	-1331.3	-1331.4
LR statistic:	55.5	49.8	38.9
Chi-squared:	211.3	217.2	229.4
G-squared:	203.7	209.4	220.3
Wald Test for Restrictions:		5.6968[12]	10.960[8]
Prob from Wald Test:		0.93059	0.20399

Notes: The numbers within the parentheses are the asymptotic t ratios. The numbers within the brackets are the degrees of freedom. Chi-squared and G-squared are two goodness of fit statistics (Agresti 1987).

BIBLIOGRAPHY

BIBLIOGRAPHY

A Study of Fall 1980 Illinois Community College Freshmen Earning Baccalaureate Degrees from Illinois Public Universities, 1980-1988. Springfield, Illinois: Illinois Community College Board, September 1990.

Agresti. Analysis of Ordinal Categorical Data, John Wiley and Sons, New York, 1987.

Allen, Walter R. "Black Colleges vs. White Colleges." Change, (May/June 1987): 28-34.

Amemiya, T. "Regression Analysis When the Variance of the Dependent Variable is Proportional to the Squared of Its Expression." Journal of the American Statistical Association, 1973, 928.

Anderson. "The choice of the Degree of a Polynomial Regression as a Multiple Decision Problem." Analysis of Mathematical Statistics, 33 n1 (1966): 225-265.

Anderson, Kenneth L. "Post High School Experiences and College Attrition". Sociology of Education, 54, 1981.

Astin, Alexander W. "College Dropouts: A National Profile." American Council on Education Research Reports. Washington, D.C.: American Council on Education, 1972.

________. Preventing Students from Dropping out. San Francisco, California: Jossey-Bass, 1975.

Attinasi, Louis C. "Getting In: Mexican Americans' Perceptions of University Attendance and Implications for Freshman Year Persistence." Journal of Higher Education, 60 (May/June 1989): 277-347.

Beal, Phillip E. and Lee Noel. "What Works in Student Retention." Iowa City, Iowa: American College Testing Program & National Center for Higher Education Management Systems, 1980.

Bean, T. H. "A Conceptual Model of Nontraditional undergraduate Attrition." Review of Educational Research, 55 n4 (1985), 485-540.

Belsley, David A., Edwin Kuh, and R. Welsch. Regression Diagnostics, Identifying Influential Data and Sources of Collinearity. New York: Weley, 1980.

Belsley, David A. and Edwin Kuh. Model Reliability. Massachusetts: MIT Press, 1986.

Brady, Nelvia M. "How Long Does It Take to Get a Community College Degree: The Experience of Spring 1987 Graduates of the City Colleges of Chicago." Chicago: City Colleges of Chicago, Office of Planning, Development and Research, April 1990.

Bragg, Emma W. "A Study of Student Withdrawal at W.U." Journal of Educational Psychology, 47 (January 1956): 199-202.

Cameron, A. and P. Trivedi. "Econometric Models Based on Count Data: Comparisons and Applications of Some Estimators." Journal of Applied Econometrics, 1 n1, 1986.

________. "Regression Based Tests for Overdispersion in the Poisson Model." Journal of Econometrics, 46 (1990): 347-364.

Campbell, R. T. "The Freshman Class of the University of Wisconsin, 1964." Longitudinal Perspectives on Educational Attainment, edited by A Kerckhoff. Greenwich, Conn.: JAI Press, 1980.

Carrol, C. Dennis. "Post-secondary Status and Persistence of High School Graduates of 1980." Washington D.C.: U.S. Government Printing Office for U.S. Department of Education, National Center for Education Statistics, 1985.

________. "Student Financial Assistance and College Persistence and Completion." Paper presented at National Association of State Scholarship and Grant Programs Annual Meeting, September 1987.

________. "Bulletin: Enrollment in Post secondary Education by 1980 and 1982 High School Graduates." Washington

D.C.: U.S. Department of Education, National Center for Education Statistics, July 1988.

Chann, Clara. "A Study of the Length of Enrollment of Graduates of Occupational Programs in a Community College." ED.D. diss., Northern Illinois University, 1987.

Chickering Arthur W. Commuting Versus Resident Students, Overcoming the Educational Inequities of Living Off Campus. San Francisco, California: Jossey-Bass, 1974.

College Attainment Four Years After High School. Washington, D.C.: The Center, June 1981. NCES Report 82-216.

Cowart, Susan. "What Works in Student Retention in State Colleges and Universities." Iowa City, Iowa: National Center for Advancement of Education Practices, 1987.

Cross, K. Patricia. Beyond the Open Door. New Students to Higher Education. San Francisco, California: Jossey-Bass, 1983.

Crawford, A. B. "Those Who Graduate: A Brief Look at the UNO Graduating Class of 1986." Omaha: Nebraska University, February 1989.

Deegan, W., D. Tillery, and Associates. Renewing the American Community College. San Francisco, California: Jossey-Bass, 1985.

Demitroff, J. F. "Student Persistence." College and University, 49 (1974): 553-567.

Demos, G. D. "Analysis of College Dropouts-Some Manifest and Covert Reasons." Personnel and Guidance Journal, 46 (March 1968): 681-684.

Dennison, John D. "Degree Completion at British Columbia's Universities." Canadian Journal of Higher Education, 12 n2 (1982): 43-57.

Dillon, Paul H.. "The Myth of the Two-Year College: Length and variation in the Time Students Take to complete Associate Degree Requirements." Los Angeles, California: Planning and Development, Office of

Research, Los Angeles Community College District, September 1990.

Dossugi, Samuel. "Determinants of Student Course Withdrawals." D.A. diss., Middle Tennessee State University, 1992.

Durkheim, Emile. Suicide. Translated by John A. Spaulding and George Simpson. Glencoe, IL: The Free Press, 1951.

Eckland, Bruce K. "College dropouts who came back." Harvard Educational Review. 34, 1964.

Eckland, Bruce K. and Louise Henderson. "College Attainment Four Years After High School". Durhem, North Carolina: Center for Educational Research and Evaluation, Research Triangle Institutions, June 1981.

Factors Influencing Student Pace Toward Acquisition of the Baccalaureate Degree at the University of California. Berkeley, California: Office of the President, November 13, 1987.

Fetters, William B. National Longitudinal Study: Withdrawal from Institutions of Higher Education. Washington, DC: National Center for Education Statistics, 1977.

Fishman, J. A. and A. K. Pasanella. "College Admission-Selection Studies." Review of Educational Research, 30 (October 1960): 289-310.

Flax, M. J. Blacks and Whites. Washington, DC: The Urban Institute, 1971.

Frances, Carol. "College Enrollment Trends: Testing the Conventional Wisdom Against the Facts." Washington D.C.: Association Council for Policy Analysis and Research, American council on Education, 1980.

Gleazer, E. J. "The Community College Issue of the 1970s." The Educational Record, 51 (1970): 47.

Greene, William. Econometric Analysis. New York: Macmillan, 1990.

________. Limdep. Australia: Econometric Software, Inc., 1991.

Gregory, Shirley M. "Does Co-op Really Make a Difference? A Look at Graduation and Retention." Oregon:' Reports-Research (143), 1990.

Grosset, Jane. "A Profile of the Enrollment Behavior of 1990 Associate Degree Recipients at Community College of Philadelphia." Report #59. Philadelphia: Office of Institutional Research, Philadelphia Community College, June 1991.

Haberman, Shelby J. Analysis of Qualitative Data. New York: Academic Press, 1978.

Hendry, D. F. "Predictive Failure and Econometric Modeling in Macrocreconomics: The Transactions Demand for Money" edited by Paul, Economic Modeling, London: Heinemann, 1979: 217-242

Hill, Susan. "OERI Bulletin: Completion Time for Bachelor's Degrees." Washington D.C.: Association Council for Policy Analysis and Research, American Council on Education, 1986.

Hinton, Hortense Beck. "An Analysis of The Factors Contributing to The On-Time Graduation of Black Students at the University of Virginia." ED.D. diss., University of Virginia, 1988.

Hodgkinson, H. L.." All One System: Demographics of Education, Kindergarten Through Graduate School." Washington, D.C.: Institute for Educational, 1985.

Iffert, R. E. "Retention and Withdrawal of College Students." Bulletin 1958, no. 1. Washington, DC: U.S. Government Printing Office, 1957.

Intriligator, Michael D. Econometric Models, Techniques, and Applications. Englewood Cliffs, NJ: Prentice Hall., 1978.

Jex, F. B. and R. M. Merrill. "A Study in Persistence." Personnel and Guidance Journal, 40 (1962) 762-769.

Johansson, C. B. and J. E. Rossman. "Persistence at a liberal arts college: A Replicated Five-year Study." Journal of Counseling Psychology, 20 (1973): 1-9.

Kemerer, Frank R., Victor Baldridge, and Kenneth C. Green. "Strategies for Effective Enrollment Management." Washington, D.C.: American Association of State Colleges and Universities, 1982.

Kennedy, Peter. A Guide to Econometrics. Massachusetts: MIT Press, 1987.

Kimball, Robert Harry. "A Study of Variables Which Predict On-Time and Late Graduation (Graduation, Persistence)." ED.D. diss., University of Houston, 1991.

Knepper, Paula R. "Student Progress in College: NLS-72 Post secondary Education Transcript Student, 1984. Survey Report." Washington, D.C.: National Center for Education Statistics, Washington, 1989.

Knight, William E. "Time to Associate Degree Study: The Experience of May, 1990 Graduates of the Kent State University Regional Campuses." Kent, Ohio: Academic Assessment and Evaluation Services, Kent State University Regional Campuses, Lincoln Building, October 1990.

Knoke, David and Peter J. burke. Log-Linear Models. Beverly Hills, London: Sage Publications, 1983.

Korb, Roslyn, Nancy Schantz, Peter Stowe, and Linda Zimbler. "Undergraduate Financing of Post secondary Education: A Report of the 1987 National Post secondary Student Aid Study." Washington D.C.: U.S. Department of Education, National Center for Education Statistics, 1988.

Krieger, Thomas Bert. "A Longitudinal Study of The Relationship Between Federal Financial Aid Packaging and Retention for the Members of the Freshman Class of 1974-1975 at Troy State University." PH.D. diss., The Florida State University, 1980.

Lavin, D. E., J. Murtha, and B. Kaufman. "Long term graduation rates of students at the City University of New York." New York: City University of New York, Office of Institutional Research and Analysis, 1984.

Lenning, Oscar T. "Variable-Selection and Measurement Concerns." Studying Student Attrition. edited by Ernest

T. Pascarella, 35-53. San Francisco, CA: Jossey-Bass, Inc., 1982.

Maddala, Peter. Economics Handbook Series. New York: McGraw Hill Book Company, 1977.

________. A Guide to Econometrics. Massachusetts: The MIT Press, 1987.

Merritt, J. E. "Analysis of Academic Achievement, Biographical Characteristics, in Relation to Persistence Descriptors of Selected Virginia Community College Students." Ph.D. diss., University of Virginia, 1974.

Mishler, C. et al. "Adult Students' Pace Toward Graduation." College and University, 57 n1 (1982): 31-41.

Munro, Barbara Hazard. "Dropouts from Higher Education: Path Analysis of a National Sample." American Educational Research Journal, 18 (Summer): 133-141

MTSU Sidelines "Tradition Four-year Degree Now an Endangered Species." Murfreesboro, Tennessee: Middle Tennessee State University, April 5, 1993.

MTSU Undergraduate Catalog Murfreesboro, Tennessee: Middle Tennessee State University, 1991-1993.

Nasaw, D. Schooled to Order: A Social History of Public Schooling in the United States. New York: Oxford University Press, 1981.

Naylor, P. D. and T. R. Sanford. "Intrainstitutional Analysis of Student Retention Across Student Levels." College and University, (Winter 1982): 143-159.

Nelson, A. Gordon. "College Characteristics Associated with Freshman Attrition." Personnel and Guidance Journal, 44 (June 1960): 1046-1050.

Nelson, Robert B., Thomas B. Scott, and William A. Bryan. "Precollege Characteristics and Early College Experiences as Predictors of Freshman Year Persistence." Journal of College Student Personnel 25 (January 1984): 50-54.

Newlon, L. L. and G. G. Gaither. "Factors Contributing to Attrition: An Analysis of Program Impact on Persistence Patterns." College and University, (Spring 1980): 237-251.

Ostar, A. "The Four Year Myth." Higher Education and National Affairs, June 1, 1987.

Pantages, T. J. and C. F. Creedon. "Studies of College Attrition: 1950-75." Review of Educational Research, 48 n1 (1978), 49-101.

Pedrini, Bonnie C., and D. T. Pedrini. "Evaluating Experimental and Control Programs for Attrition/Persistence." The Journal of Educational Research 71 (March/April 1978): 234-237.

Pindyck, S. Robert and Daniel L. Rubinfeld. Econometric Models and Economic Forecasts. New York: McGraw-Hill, 1991.

Plummer, Jerry D. "An Analysis of the Usefulness of Developmental Study Courses in Higher Education Principles of Economics Courses." D.A. Diss., Middle Tennessee State University, 1991.

Robb, Patricia Stafford. "Factors Affecting the Time to Degree". Division of Analytic Studies. Long Beach: Office of the Chancellor, January 1988.

Rouche, J. E., G. A. Baker and R. L. Brownell. "Accountability and the Community College: Directions for the '70s." Washington, D.C.: American Association of Junior Colleges, 1971.

Sewell, William H. and Vimal P. Shah. "Socioeconomic Status, Intelligence, and the Attainment of Higher Education." Sociology of Education, 40 (Winter 1967): 1-23.

Slocum, W. L. "Social Factors Involved in Academic Mortality." College and University, 32 (Fall 1956): 53-64.

Solomon, R. B. "A different drummer: The CCC College." Atlanta, Georgia: Life-long Learning Library, 1976.

Spinetta, Katrin and J. A. Phillips. "Time-To-Degree."

Oakland, California: Peralta Community College system, 1991.

Stork, Diana, and Paul D. Berger. "Attrition in the Liberal Arts College of a Major Metropolitan University." Research in Higher Education, 9 (1978): 281-289.

Students Receiving Federal Aid Are Not Making Satisfactory Academic Progress: Tougher Standards Are Needed. Report to the Chairman, Committee on Labor and Human Resources, United States Senate. Washington, D.C.: Comptroller General of the U.S., 1981.

Suddarth, B. M. "Factors Influencing the Graduation of Freshmen Who Enroll at Prudue University." 1957, Unpublished Report. Cited in Nevitt Sanford, (ED.). The American College. New York, NY: John Wiley & Sons, Inc., 1962.

Summerskill, J. "Dropouts from College." In N. Sanford (Ed.), The American College. New York: Wiley, 1962.

Terenzini, P. T., Lorang, W. G., and Pascarella, E.T.. "Predicting Freshman Persistence and Voluntary Dropout Decisions: A Replication". Research in Higher Education, 15 n1 (1981): 109-127.

Time Required to Earn the Bachelor's Degree. Sacramento, California: California Post secondary Education Commission, March 1987. Commission Report 87-14.

Time to Degree in California's Public Universities Factors Contributing to the Length of Time Undergraduates Take to earn Their Bachelor's. Sacramento, California: California State Post secondary Education Commission, March 1988. Report 88-12.

Tinto, V. "Dropouts from Higher Education: A Theoretical synthesis of Recent Research". Review of Education Research, 45 (1975): 89-125.

________. "Limits of Theory and Practice in Student Attrition". Journal of Higher Education, 53 n6 (1982): 687-700.

________. "Defining Dropout: A Matter of Perspective.". Studying Student Attrition, edited by Ernest T.

Pascarella, 3-15. San Francisco, CA: Jossey-Bass, 1982.

________. Leaving College-Rethinking the Causes and Cures of Student Attrition. Chicago: University of Chicago Press, 1987.

Trent, J. and J. Ruyle. "Variations, Flow and Patterns of College Attendance." College and University, 41 (1965): 61-76.

Vaughan, G. B. and Associates. Issues for Community college leaders in a new era. San Francisco, California: Jossey-Bass, 1983.

________. "Balancing Open Access and Quality." Change, (March 1984): 28-44.

Welsh, Michael F. "A Comparative Study of Persistence, Time to Graduation, and Changes in Major Among Undeclared and Declared Majors at The University of South Carolina During The Period 1976-1983." ED.D. diss., University of South Carolina, 1984.

White, H., "A Heteroskedasticity Consistent Covariance Matrix and a Direct Test for Heteroskedasticity." Econometrics, 1978: 817-838.