

**Assessment of Student Attrition at the Faculty of Science,
Addis Ababa University**

By

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DECLARATION

I, the undersigned, declare that this thesis is my work and all sources of material used for this thesis have been duly acknowledged.

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Fitsum A.

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Abstract

The purpose of this study was to examine the models, which might be appropriate to represent the attrition rate of students at the Faculty of Business and Economics (FBE), Addis Ababa University (AAU). In addition, the study attempted to estimate the magnitude and pattern of academic survival rates of students and compares the survival rates of male and female students.

The attrition data from the batch of 1994/95 to 1998/99 were used in the study. The data sources were the Records Office of FBE and the Office of the Registrar of AAU.

The findings of the study revealed that among the four models examined, two of the Guttman and Olkin

model (1989) and the reparametrized model

(Temesgen, 1991) were found to be adequate to represent the attrition rate of students at FBE.

The findings also showed that about 67% of the students of Batch I was able to complete five semesters while this figure increased to 88% for Batch V. Here it should be noted that the academic survival rates of students increased from batch to batch. It was also found that even though the

survival rates of female students was lower than male students for the five batches, still there was no observed statistical difference between the academic survival rates of male and female students.

CHAPTER ONE

Introduction

1.1 General

Any country's capacity to generate, accumulate, deploy and utilize knowledge, skills and information is critical to its development. Progress and development increasingly depend upon the training, research, invention, innovation and adaptation of educated minds. Education is the most effective means that any society has to possess for confronting the current and future socio-economic challenges, and indeed to shape our world of tomorrow.

Higher education contributes to human resource development in many ways. Higher education institutions have the main responsibility for training a country's professional personnel who participate in development, adaptation, and diffusion of innovations in the economy. Such institutions should create new, or continually extend, the boundaries of existing knowledge through research and advanced training, and serve as a conduit for knowledge transfer, adaptation and dissemination. Social, cultural and economic development is mainly based on alleviation of poverty, which requires the development of human resources with the necessary attitudes, skills and knowledge. Higher

education stands out as one of the keys to setting in motion those

broader processes, which are necessary to cope with the challenges of the future. It is therefore, unquestionable that higher education institutions are the major powerhouses in which development process of our society and our future relies.

Since the introduction of modern education in Ethiopia around 1907 the country has made a substantial progress in this field. Although, higher education started over half a century ago, its development and expansion in Ethiopia is limited. Due to space limitations at higher education institutions enrollment of students is low, considering the size of the population. During the last five years enrollment and the number of graduates in higher education in Ethiopia has increased substantially. Total enrollment in MOE sponsored and other (governmental, non-governmental and private) higher education institutions has reached over 60,000 in the 1999/2000 academic year (A.Y.). Although the total number is still low, the number of graduates has also increased from about 3300 in A.Y. 1994/95 to 8200 in A.Y. 1998/99 (Ministry of Education). From the above figures, the skilled human resource coverage in the country is too low.

1.2 Statement of the problem

In most cases, attention has been given to the enrollment of students to higher education. Even if, the goal to improve undergraduate recruitment and retention needs no justification, great concern has to be given to the issue of student attrition, which has been a serious and long-standing problem in higher education institutions.

Student attrition is a reality, which universities and the governments funding them need to understand better to decide on the relevancy of retention programs. Attrition is not necessarily a bad thing. The assumption that all students enter higher education institutions intending to complete, is no longer reasonable for at least a significant minority of students.

However, different questions arise as to whether attrition is the result of characteristics of individual students or of factors inherent in the structure, process and culture of undergraduate education. Numerous studies have sought to identify models and sets of variables to explain what causes students force to leave the tertiary education system. For most students, deciding to leave tertiary education is not the result of one factor. Rather, it is the result of a combination of complex, interconnected factors that develop over time. Many studies have

identified previous academic performance, mismatches between student expectations and experiences, student disorientation or socialization, other factors being key predictors of attrition. Furthermore, students may be required to leave for reasons of poor academic performance or they may leave voluntarily despite adequate academic progress. Barbara Lovitt (2000) paper argues that attrition has less to do with what students bring to the university than with what happens to them after they have been admitted, especially the culture of the program. Tinto (1993) identifies two forms of student attrition, namely academic dismissal and voluntary withdrawal. Tinto argues that some academic dismissals are a result of a decision made by the individual not to invest the time and energy needed to maintain minimum academic standards. According to Archer, Cantwell, and Bourke (1997) there are many variables that are likely to affect the academic success of students who enter university through enabling programs. The authors quote age, gender, educational and family circumstances, ability, self-confidence, achievement goals, and approaches to self-regulation of academic behaviour as some of the main variables that affect a students performance severely. Bull (2000) acknowledges that success and attrition in higher

education is often dependent upon the pre-requisite skills, knowledge and commitment of successful students. The author goes on to mention that low levels of basic skills, an inadequate knowledge base and low self-confidence are all factors contributing to the failure and attrition of students in undergraduate programs. Confidence, self-efficacy and self-esteem also seem paramount to new student success. Archer, Cantwell and Bourke (1999) report that students need to feel confident and that they cannot be successful if this confidence is not strong.

Pascarella, Terenzini, and Wolfe (1986) emphasize the influence of faculty involvement on student retention and satisfaction with education. Overall faculty-student contact is an important factor in student achievement, persistence, academic-skill development, personal development, and general satisfaction with the college experience Kramer and Spencer (1989). They also indicate that academic advising can reduce alienation and enhance learning.

Villella and Hu (1991) revealed that the time constraints of college terms and the amount of academic rigor required in college courses can lead to student stress and

dissatisfaction. These factors can result in students leaving college.

According to Noel (1985) the major themes related to attrition appear to be academic boredom (i.e. classes not challenging) and uncertainty about what to study, transition/adjustment problems, limited and/or unrealistic expectations of college, academic under-preparedness, incompatibility, and irrelevancy.

Pantages and Creedon (1978) reported that the largest attrition rate occurs among freshmen. Attrition studies by some research have found that first term grades correlate positively with student persistence (Somers 1996; Hoyt 1999; Molnar 1993). Many studies that consider gender as a predictor for attrition have found that attrition rates for women in the higher education system is significantly higher than for men (Pedrini 1976; Max 1969; Astin 1975; Brabant and Garbin 1976; Cope 1968; Pascarella and Terenzini 1979b; Cope, Trapp and Pailthorp 1971; McDermott and Lichtenstein 1974; Etaugh and Bowen 1976; Newlon and Gaither 1980; Allen 1997; Isonio 1994; Smith 1992; Knibbe and Dusewicz 1990; and York, Bollar and Schoob 1993). On the other hand, some studies have found that men are more likely to persist (Brawer 1996). A lot of research results show that attitude and motivation are more important than

grades in determining which students drop out (Reyes 1997). Other factors that have shown to be related to the attrition of students include family conflicts (Sydow and Sandel 1998), parental support (Allen 1997), personal problems (Ogletree 1992), and health problems (Pantages and Creedon 1978; Gilmore 1995).

Tinto (1975, 1982, 1987) used Spady's work (1970, 1971) and Durkheim theory of suicide (1951) to develop a theory explaining the process that induces students to leave colleges and university before graduating. This theory articulates that personal characteristics and demographic and related characteristics (gender socio-economical status, ethnicity, etc.) produce varying level of initial commitments to educational goals and to specific institutions. It argues that once a student enrolls in a particular institution of higher learning these initial commitments interact with the economic and social components of university life, resulting in different levels of academic and social integration. According to Tinto (1987), academic integration stems not only from the student academic performance but also from the interaction with staff, while social integration reflects student participation in, and satisfaction with extra curricular activities and peer group relations. The theory argues

that, all other factors being equal, a match between an individual student characteristics and the institutions academic and social components determine the student's commitment to university completion and the subjects commitment to their university. These two final commitments, together with the levels of academic and social integration, have a direct effect on decisions to persist or withdraw from the University.

Some related studies have been done to investigate probable causes of attrition at Addis Ababa University. For example, Yusuf Omar Abdi and *et al.* (1989) showed that the cause for a great number of college dropouts was academic dismissals rather than non-academic reasons. A study by Temesgen (1991) concluded that the attrition rate of freshman students decreases linearly over time and the progress of students in consecutive semesters appeared to show a difference from cohort to cohort.

As has been indicated above, student dropout from the institutions of higher education has been a subject of significant research.

Since a proportion of students leave their study the present undertaking is an attempt to make a statistical analysis and examine student attrition rates.

The result of the study may stimulate educational researchers to further and detailed investigations about attrition. It may also shed light on matters related to proper budgeting, manpower planning and assessment of overall learning environment and operational efficiency.

1.3 The study area

The study area is Faculty of Business and Economics, Addis Ababa University. This Faculty comprises the Departments of Accounting, Economics, Management and Public administration.

1.4 Objectives of the study

The main objective of the study is to find out to what degree and extent and in what fashion the process of academic survival and attrition differed among students.

The specific aims of the study are:

- To examine the attrition models.
- To estimate the magnitude and pattern of survival rates of students.
- To compare the academic survival rates of students by sex as they progress in the course of the study.

1.5 Overview of the study

In chapter one, the introductory part, the statement of the problem, the study area and the objectives of the

study are discussed. The data and methodology that are used to achieve the objectives of the study are introduced and discussed briefly in chapter two. While chapter three presents the results obtained by applying the methods described in chapter two. In chapter four discussions and recommendations are made based on the results. Finally, the appendix consists of the data, the survival and hazard functions obtained by SPSS.

Chapter Two

Data and methodology

2.1 The data

The data for this study were obtained from the Records Office of the Faculty of Business and Economics (FBE) and the Registrar Office, Addis Ababa University. The data were consisting the number of regular undergraduate degree program students who joined the FBE at the beginning of each semester as second year, third year, and fourth year students.

In this study attrition represents the number of students who leave the Faculty for good due to academic dismissals, who withdraw from the system and those who are given the status of academic dismissal but are eligible to return after being out of the university system for one or more semesters. The data from 1994/95 to 1998/99 academic years were used in the study.

2.2 Methodology

2.2.1 Modeling attrition

One of the purposes of this thesis is to study attrition as a probability model over time. The data required for modeling attrition are the total number of admitted

students each semester consisting of new students plus those figures carried over from the previous semester, and the total attrition at the end of the semester. A lay-out for the attrition data is given below.

Semester	1	2	.....	K	Total
Number of students entering	N_1	N_2	.....	N_k	N
Attrition	A_1	A_2	.....	A_k	A
Number of students remaining	R_1	R_2	.....	R_k	R

Clearly, $R_j = N_j - A_j$, $j=1, 2, \dots, k$.

There are different models that might be useful in modeling attrition. The models that are suggested by Guttman and Olikin (1989) will be discussed in the next sections. In the models that we discuss below assume that there is a dampening of the rate of attrition as we move from one semester to the other. Due to this assumption the attrition rate is given by $\pi_j = \frac{A_j}{N_j}$, $j=1, 2, \dots, k$ will generally be in descending order; that is, $\pi_1 \geq \pi_2 \geq \dots \geq \pi_k$

Model A

Let π denote the initial probability of attrition for the first semester. Further let ρ , $0 < \rho \leq 1$, be a dampening effect parameter, so that the probability of an attrition for the second semester is $\rho\pi$. For instance, if we assume

a constant attrition rate, then the probability of attrition for the third semester is $\pi\rho^2$, and so on.

Thus we have the model

	Model A				
Semester	1	2	3	.....	k
Probability of attrition	π	$\pi\rho$	$\pi\rho^2$	.....	$\pi\rho^{k-1}$

That is, for a given batch the probability of attrition is

$$\pi_j = \pi\rho^{j-1} \quad , \quad j=1, 2, \dots, k \quad (1)$$

To estimate the parameters π and ρ , we consider the joint likelihood

$$L = \prod_{j=1}^k \binom{N_j}{A_j} \pi_j^{A_j} (1 - \pi_j)^{R_j} \quad (2)$$

The use of (2) tacitly assumes that there is no carry-over effect from semester to semester, and that the observations from semester to semester are independent. In the case of model A, we have

$$\pi_j = \pi\rho^{j-1}, \quad j=1, 2, \dots, k .$$

The maximum likelihood equations are obtained by taking the logarithm of L and setting the derivatives, with respect to π and ρ , equal to zero. That is,

$$\frac{\partial \log L}{\partial \pi} = \sum_{j=1}^k \frac{A_j}{\pi} - \sum_{j=1}^k \frac{R_j \rho^{j-1}}{1 - \pi \rho^{j-1}} = 0 \quad (3)$$

$$\frac{\partial \log L}{\partial \rho} = \frac{1}{\rho} \left(\sum_{j=1}^k (j-1) A_j - \sum_{j=1}^k \frac{(j-1) R_j \pi \rho^{j-1}}{1 - \pi \rho^{j-1}} \right) = 0 \quad (4)$$

The maximum likelihood estimators of π and ρ are obtained from the simultaneous solutions of (3) and (4). Although the solutions of equations (3) and (4) cannot be given in a closed form, we can get the maximum likelihood estimators of π and ρ using the SAS/S-PLUS computer program.

To check for the validity of the model the Chi-square goodness-of-fit statistic will be computed.

In order to obtain the asymptotic distribution of the maximum likelihood estimators of π and ρ , we evaluate the information matrix

$$\mathbb{I} = \begin{bmatrix} I_{11} & I_{12} \\ I_{12} & I_{22} \end{bmatrix}$$

where

$$I_{11} = I_{\pi\pi} = -E \left[\frac{\partial^2 \log L}{\partial \pi^2} \right]$$

$$I_{12} = I_{\pi\rho} = -E \left[\frac{\partial^2 \log L}{\partial \pi \partial \rho} \right]$$

$$I_{22} = I_{\rho\rho} = -E \left[\frac{\partial^2 \log L}{\partial \rho^2} \right]$$

With $\bar{\pi}_j = 1 - \pi_j$, the information matrix is given as

$$I = \begin{bmatrix} \frac{1}{\pi^2} \sum \frac{N_j \pi_j}{\bar{\pi}_j} & \frac{1}{\pi\rho} \sum \frac{N_j (j-1) \pi_j}{\bar{\pi}_j} \\ \frac{1}{\rho^2} \sum \frac{N_j \pi_j (j-1)^2}{\bar{\pi}_j} & \end{bmatrix}$$

from which the bivariate normal distribution of $(\hat{\pi}, \hat{\rho})'$ is given as $(\hat{\pi}, \hat{\rho})' \sim N((\pi, \rho), I^{-1})$.

Model B

The assumption in this model is that the dampening effect in the first semester is strong but subsequently the effect will be less. Therefore, we can introduce a non-negative parameter γ , the purpose of which is to lessen the rate of attrition. Accordingly for Model B we have

Model B	
Semester	1 2 3 4 k
Probability of attrition	π $\pi\rho$ $\pi\rho\rho^\gamma$ $\pi\rho\rho^{2\gamma}$ $\pi\rho\rho^{(k-2)\gamma}$

That means, for a given batch of students

$$\pi_j = \begin{cases} \pi\rho^{j-1}, j=1,2 \\ \pi\rho^{(j-2)\gamma+1}, j=3,4,\dots,k \end{cases} \quad (5)$$

To estimate the parameters π, γ and ρ , again we begin with the joint likelihood function.

The likelihood function for model B is given by (2) with

$$\pi_j = \pi\rho^{j-1}, j=1,2 \text{ and } \pi_j = \pi\rho^{(j-2)\gamma+1} \text{ for } j=3,4,\dots,k.$$

The maximum likelihood equations become

$$\frac{\partial \log L}{\partial \pi} = \sum_{j=1}^k \frac{A_j}{\pi} - \sum_{j=1}^k \frac{R_j \rho_j}{1 - \pi \rho_j} = 0 \quad (5)$$

$$\frac{\partial \log L}{\partial \rho} = \pi \left(\sum_{j=2}^k \frac{A_j}{\pi \rho} + \frac{\gamma}{\pi \rho} \sum_{j=3}^k (j-2) A_j - \frac{R_2}{1 - \pi \rho} - \sum_{j=3}^k \frac{R_j [1 + (j-2)\gamma] \rho^{(j-2)\gamma}}{1 - \pi \rho^{(j-2)\gamma+1}} \right) = 0 \quad (6)$$

$$\frac{\partial \log L}{\partial \gamma} = (\log \rho) \left(\sum_{j=3}^k (j-2) A_j - \pi \sum_{j=3}^k \frac{(j-2) R_j \rho^{(j-2)\gamma+1}}{1 - \pi \rho^{(j-2)\gamma+1}} \right) = 0 \quad (7)$$

where $\rho_1 = 1, \rho_2 = \rho, \rho_j = \rho^{1+(j-2)\gamma}$ for $j=3,4,\dots,k$

Again the solution for the maximum likelihood equations cannot be given in a closed form. However, the ML estimators of π, ρ and γ can be obtained using the SAS/S-PLUS program. The validity of the model will be examined using the Chi-square goodness-of-fit.

To find the asymptotic distribution of the maximum likelihood estimators of π, ρ and γ , we evaluate the 3x3 information matrix I

$$I = (I_{ij}) \quad i, j=1, 2, 3$$

with components

$$I_{11} = I_{\pi\pi}, I_{12} = I_{\pi\gamma}, I_{22} = I_{\rho\rho}, I_{23} = I_{\rho\gamma}, I_{33} = I_{\gamma\gamma}$$

where

$$I_{11} = \frac{1}{\pi^2} \sum_{j=1}^k \frac{N_j \pi_j}{\bar{\pi}_j}$$

$$I_{12} = \frac{1}{\pi\rho} \sum_{j=2}^k \frac{N_j \pi_j}{\bar{\pi}_j} [(j-2)\gamma + 1]$$

$$I_{13} = \frac{\log \rho}{\pi} \sum_{j=3}^k \frac{N_j \pi_j (j-2)}{\bar{\pi}_j}$$

$$I_{22} = \frac{1}{\rho^2} \sum_{j=2}^k \frac{N_j \pi_j}{\bar{\pi}_j} [1 + (j-2)\gamma]^2$$

$$I_{23} = \frac{\log \rho}{\rho} \sum_{j=3}^k \frac{N_j \pi_j}{\bar{\pi}_j} (j-2)[(j-2)\gamma + 1]$$

$$I_{33} = (\log \rho)^2 \sum_{j=3}^k \frac{N_j \pi_j}{\bar{\pi}_j} (j-2)^2$$

From which we conclude that the tri-variate normal

distribution of $(\hat{\pi}, \hat{\rho}, \hat{\gamma})'$ is given by $(\hat{\pi}, \hat{\rho}, \hat{\gamma})' \sim N$

$((\pi, \rho, \gamma), I^{-1})$.

Model C

In many attrition situations, there is a very slow drift downward from the initial attrition probability, which suggests that this model may be appropriate for such data. Here the probability of attrition for the j^{th} semester is π_j , where

$$\pi_j = \frac{\tau^j}{(1+\tau^j)} \quad , \quad j=1,2,\dots,k \quad (8)$$

with a positive valued parameter τ .

If $0 < \tau \leq 1$ then $\pi_1 \leq 1/2$, whereas $\tau > 1$ implies that $1/2 < \pi_1 \leq 1$.

In this case, the π_j 's of (8) decrease as j increases, provided that $0 < \tau < 1$, and they increase as j increases when $1 < \tau < \infty$. For this reason, we assume that $0 < \tau < 1$, so that the expected usual decreasing behavior of the π_j encountered in attrition situations is realized.

To obtain the maximum likelihood estimators, as in Models A and B, again we use the likelihood function as given in (2), where the π_j 's are now given by (8). Note that

$$\frac{\partial \pi_j}{\partial \tau} = \frac{j\tau^{j-1}}{(1+\tau^j)^2} = \frac{j}{\tau} \pi_j \bar{\pi}_j \quad (9)$$

With $\bar{\pi}_j = 1 - \pi_j$.

Using (2) and (9), the maximum likelihood equation becomes

$$\frac{\partial \log L}{\partial \tau} = \frac{1}{\tau} \left\{ \sum_{j=1}^k \frac{[jA_j - jR_j \tau^j]}{(1 + \tau^j)} \right\} = 0 \quad (10)$$

We can get the maximum likelihood estimator of τ using the SAS/S-plus program. The Chi-square goodness-of-fit statistic for the validity of the model will be computed.

To find the asymptotic distribution of the MLE, $\hat{\tau}$ of τ , we evaluate the information matrix. A second order differentiation of (2) with respect to τ combined with (9) yields the information

$$I = -E \left[\frac{\partial^2 \log L}{\partial \tau^2} \right] = \frac{1}{\tau^2} \sum_{j=1}^k N_j j^2 \pi_j \bar{\pi}_j .$$

Hence, we find that, for N_j 's that are large the distribution of the quotient $\hat{\tau} / \tau$ is the univariate normal given as

$$\frac{\hat{\tau}}{\tau} \sim N(1, [\sum N_j j^2 \pi_j \bar{\pi}_j]^{-1}) .$$

2.2.2 Estimation of the survivor function

Since data on attrition and survival have characteristics which are very similar to failure time data, Kaplan-Meyere estimation procedure was employed to determine the magnitude and pattern of students survival and attrition rates over the j th semester $j = 1, 2, \dots, k$.

In what follows we introduce notations that we need in the subsequent discussion.

Let n_j be the number of students registered in the j^{th} semester, d_j be the total attrition in the j^{th} semester, and p_j be the conditional probability of surviving beyond the j^{th} semester.

The estimator of p_j is then given by

$$\hat{p}_j = \frac{n_j - d_j}{n_j} = 1 - \hat{q}_j$$

where $\hat{q}_j = \frac{d_j}{n_j}$ is the estimated conditional probability of attrition at the j^{th} semester.

The *cumulative proportion of survival* at the k th semester or the *Kaplan-Meyer survivor function* estimator $P(k)$, is estimated by

$$\hat{P}(k) = \prod_{j=1}^k \hat{p}_j .$$

The formula due to Greenwood (1926) can be adapted to estimate the asymptotic variance of $\hat{P}(k)$, and it is given as

$$\text{Var}[\hat{P}(k)] = [\hat{P}(k)]^2 \sum_{j=1}^k \frac{d_j}{n_j(n_j - d_j)}$$

A heuristic derivation of an asymptotic variance formula for $\hat{P}(k)$ is discussed in Kalbfleisch and Prentice (1980) and Marubini and Valsecchi (1995).

2.2.3 Comparison of survival curves

To compare the equality of the survival functions for the two groups, in this case males and females, the non-parametric approach is usually adopted. Among the various non-parametric tests one can find in the statistical literature, the Mantel-Haenzel (M-H) test (1959), commonly known as the log-rank test, will be discussed below.

The M-H test is the most frequently used statistical tool for comparing two or more estimated survival curves. This statistic makes efficient utilization of the available data by summarizing the differences between survivor functions over k semesters.

Suppose n_{mj} and n_{fj} respectively represent the number of male and female students registered in the j^{th} semester. Let d_{mj} and d_{fj} stand for the male and female attrition in the j^{th} semester.

Then the ***null hypothesis*** is that "the survival probability in both groups (male and female) is the same".

The ***alternative hypothesis*** is simply "the survival probabilities for the two groups are different".

To conduct a formal test of null hypothesis, we construct a 2x2 contingency table for each semester.

Gender	Attrition at semester j	Number of survivors in semester j
Male	d_{mj}	$n_{mj}-d_{mj}$
Female	d_{fj}	$n_{fj}-d_{fj}$
Total	d_j	n_j-d_j

Mantel and Haenzel (1959) suggest considering the distribution of the observed cell frequencies on the marginal totals under the null hypothesis. This implies, in turn, considering the distribution of just one cell, say d_{mj} , since the other frequencies are implicitly determined by the fixed marginals.

Under the null hypothesis, the distribution of d_{mj} can be shown to be hypergeometric with mean

$$E(d_{mj}) = n_{mj} \times \frac{d_j}{n_j}$$

and variance

$$Var(d_{mj}) = \frac{n_{mj}n_{fj}d_j(n_j - d_j)}{n_j^2(n_j - 1)}.$$

For the detail see Kalbfleisch and Prentice(1980) and Marubini and Valsecchi(1995).

It can also be shown that, under the null hypothesis, the ratio

$$\chi_j^2 = \frac{[d_{mj} - E(d_{mj})]^2}{\text{var}(d_{mj})} \quad (11)$$

is approximately distributed as chi-square with one degree of freedom.

The statistic

$$U = \sum_{j=1}^k [d_{mj} - E(d_{mj})].$$

takes into account the information addressed by all tables.

Conditionally for fixed d_j , n_{mj} and n_{fj} , the variance of U under the null hypothesis is obtained by adding the j statistics computed for each semester. Thus, the *test statistic* as suggested by Mantel and Haenzel is

$$Q_{M-H} = \frac{\left\{ \sum_{j=1}^k [d_{mj} - E(d_{mj})] \right\}^2}{\sum_{j=1}^k \text{var}(d_{mj})} = \frac{U^2}{\text{var}(U)}.$$

This statistic like (11) is approximately distributed as chi-square with one degree of freedom.

Chapter Three

Data analysis and results

3.1 Modelling attrition rates

In this section, we examine whether the models that are suggested by Guttman and Olkin (1989) are appropriate for the data given in Table 3.1.

Table 3.1. Observed attrition rates by batch

Batch	Semester				
	1	2	3	4	5
I	0.1236	0.0809	0.0780	0.0545	0.0262
II	0.0841	0.0670	0.0580	0.0388	0.0249
III	0.0658	0.0542	0.0377	0.0259	0.0152
IV	0.0563	0.0340	0.0271	0.0238	0.0199
V	0.0374	0.0284	0.0219	0.0189	0.0146

The table shows the observed attrition rates of different batches for five semesters. Batch I shows the group of the 1994/95 academic year entries,..., Batch V shows the group of the 1998/99 academic year entries.

Model A

Based on the procedure that was discussed in Section 2.2.1 the estimated parameters of model A are given in Table 3.1.2.

Table 3.1.2. Estimates of parameters of Model A

Batch	$\hat{\pi}$	$\hat{\rho}$	$S.E.(\hat{\pi})$	$S.E.(\hat{\rho})$
I	0.1221	0.7385	0.0097	0.0394
II	0.0863	0.7699	0.0046	0.0257
III	0.0686	0.7265	0.0035	0.0256
IV	0.0528	0.7465	0.0041	0.0381
V	0.0368	0.7889	0.0008	0.0104

Table 3.1.3 Shows the estimated attrition rates using model A given in (1) of Chapter 2.

Table 3.1.3. Estimated attrition rates and P-values for model A

Batch	Semester					P-value
	1	2	3	4	5	
I	0.1221	0.0902	0.0666	0.0492	0.0363	0.8231
II	0.0863	0.0665	0.0512	0.0394	0.0303	0.9794
III	0.0686	0.0498	0.0362	0.0263	0.0191	0.9865
IV	0.0528	0.0394	0.0294	0.0220	0.0164	0.9622
V	0.0368	0.0290	0.0229	0.0181	0.0143	0.9998

From the above table the P-values for all batches are greater than 0.05. Thus, we can conclude that Model A is adequate for the attrition data given in Table 3.1.3.

Model B

Table 3.1.4 presents the estimated parameters of Model B based on the procedure discussed in Section 2.2.1.

Table 3.1.4. Estimates of parameters of Model B

Batch	$\hat{\pi}$	$\hat{\rho}$	$\hat{\gamma}$	$S.E.(\hat{\pi})$	$S.E.(\hat{\rho})$	$S.E.(\hat{\gamma})$
I	0.1236	0.7102	0.8302	0.0130	0.1222	0.6324
II	0.0841	0.8324	1.6211	0.0055	0.0805	1.0369
III	0.0658	0.8315	2.1344	0.0015	0.0284	0.4651
IV	0.0563	0.5955	0.3428	0.0008	0.0154	0.0400
V	0.0374	0.7520	0.7565	0.0007	0.0231	0.1222

The estimated attrition rates using model B is given in Table 3.1.5.

Table 3.1.5. Estimated attrition rates and P-values for Model B

Batch	Semester					P-VALUE
	1	2	3	4	5	
I	0.1236	0.0878	0.0661	0.0497	0.0374	0.8116
II	0.0841	0.0700	0.0520	0.0386	0.0287	0.99043
III	0.0658	0.0547	0.0369	0.0249	0.0168	0.99962
IV	0.0563	0.0335	0.0281	0.0235	0.0197	0.99998
V	0.0374	0.0281	0.0227	0.0183	0.0147	0.99997

From Table 3.1.5 it can be seen that the P-values give sufficient evidence for the adequacy of model B ($p > 0.05$). Hence, the model fits our data.

Model C

Based on the procedure that was discussed in Section 2.2.1 the estimated parameter of Model C is given in Table 3.1.6.

Table 3.1.6. Estimates of parameters of Model C

Batch	$\hat{\tau}$	<i>S.E.</i> ($\hat{\tau}$)
I	0.1902	0.0687
II	0.1136	0.0553
III	0.0819	0.0391
IV	0.0650	0.0286
V	0.0416	0.0227

From the estimated values presented above we can estimate the attritions using Model C. The estimated attrition rates are shown below in Table 3.1.7.

Table 3.1.7. Estimated attrition rates and P-values for Model C

Batch	Semester					P-VALUE
	1	2	3	4	5	
I	0.1598	0.0349	0.0068	0.0013	0.0002	0.0000
II	0.1020	0.0127	0.0015	0.0002	0.0000	0.0000
III	0.0757	0.0067	0.0005	0.0000	0.0000	0.0000
IV	0.0611	0.0042	0.0003	0.0000	0.0000	0.0000
V	0.0399	0.0017	0.0001	0.0000	0.0000	0.0000

From the above table the P-values for all batches are smaller than 0.05. Thus, we can conclude that Model C is not adequate for the attrition data given in table 3.1.

Model D (The Reparameterized model)

In addition to the models that are suggested by Guttman and Olkin, we examine whether the reparameterized model (Temesegen, 1991) is appropriate for our data.

When the initial probability is not only the effect of first semester considered but it is assumed to be in a moderately drift downward from one semester to the next, this model might be an appropriate representation.

Here, the probability of attrition for a given batch, for the j^{th} semester is given by

$$\pi_j = \pi e^{-jr} \quad , \quad j=1, 2, \dots, k \quad (13)$$

where π is the initial probability, and r , $r>0$, is the dampening effect parameter.

The detailed discussion of this model is presented in Temesegen (1991).

Now let us see the results obtained using this model.

The estimates of the parameters are presented in Table 3.1.8.

Table 3.1.8. Estimates of parameters of Model D

Batch	$\hat{\pi}$	\hat{r}	$S.E.(\hat{\pi})$	$S.E.(\hat{r})$
I	0.1654	0.3032	0.0199	0.0534
II	0.1122	0.2615	0.0089	0.0333
III	0.0944	0.3195	0.0073	0.0352
IV	0.0707	0.2924	0.0083	0.0511
V	0.0467	0.2372	0.0015	0.0132

Based on these estimate, the estimated attrition rates using Model D is given in Table 3.1.9.

Table 3.1.9. Estimated attrition rates and P-values for Model D

Batch	Semester					P-value
	1	2	3	4	5	
I	0.1221	0.0902	0.0666	0.0492	0.0363	0.8231
II	0.0864	0.0665	0.0512	0.0394	0.0303	0.9794
III	0.0686	0.0498	0.0362	0.0263	0.0191	0.9865
IV	0.0528	0.0394	0.0294	0.0220	0.0164	0.9622
V	0.0368	0.0290	0.0229	0.0181	0.0143	0.9998

From the above table it can be seen that all the P-values are greater than 0.05. Hence we can conclude that Model D is adequate for the attrition data given in Table 3.1.

3.2 Estimation of survivor function

Based on the procedure discussed in Section 2.2.2 of Chapter 2, the survival estimates with their corresponding standard errors for all batches at each semester are computed. The estimated survivor function for all batches shown in the figure is attached in the Appendix.

As can be seen from Table 3.2.1 below or from the estimated survivor function for Batch I shown in Figure 3.2.1 (see the Appendix), about 81% of students of Batch I survived the second year, whereas after the first semester of fourth year, about 67% of the students survived.

Table 3.2.1. Students' survival estimates and standard errors of Batch I

Semester j	Survival Estimates	Standard Errors
1	0.8764	0.0201
2	0.8052	0.0242
3	0.7416	0.0268
4	0.7004	0.0280
5	0.6742	0.0287

Table 3.2.2. Students' survival estimates by sex for Batch I

Semester j	Male		Female	
	Survival	Standard	Survival	Standard
	Estimates	Errors	Estimates	Errors
1	0.8842	0.0232	0.8571	0.0399
2	0.8158	0.0281	0.7792	0.0473
3	0.7579	0.0311	0.7013	0.0522
4	0.7211	0.0325	0.6494	0.0544
5	0.6947	0.0334	0.6234	0.0552

As can be seen Table 3.2.2 above or Figure 3.2.2 the second year survival estimates of male students was about 82% while that of female students was about 80% and after the first semester of fourth year the survival rates of male and female students declined to approximately 69% and 62%, respectively.

To compare the equality of the academic survival functions of male and female students, the log-rank test statistic is applied and resulted in a non-significant difference ($\chi^2=1.26$, $df=1$, $P>0.05$) between the survival status male and female students of Batch I.

Table 3.2.3. Survival estimates of Batch II

Semester j	Survival	Standard
	Estimates	Errors
1	0.9159	0.0190
2	0.8505	0.0244
3	0.7944	0.0276
4	0.7570	0.0293
5	0.7290	0.0304

Table 3.2.3 shows the survival estimates of Batch II. From the table or figure 3.2.3 it can be observed that the probability that a student from Batch II to survive five semesters was approximately 73% with standard error 0.0304.

Table 3.2.4. Students' survival estimates by sex for Batch II

Semester j	Male		Female	
	Survival	Standard	Survival	Standard
	Estimates	Errors	Estimates	Errors
1	0.9225	0.0235	0.9059	0.0317
2	0.8605	0.0305	0.8353	0.0402
3	0.7984	0.0353	0.7882	0.0443
4	0.7597	0.0376	0.7529	0.0468
5	0.7294	0.0482	0.7287	0.0391

For Batch II the probability that both male and female student to survive five semesters was approximately the

same, which is 73% as can be seen from the above table or figure 3.2.4.

The log-rank test statistic gives sufficient evidence that there is no significant difference ($\chi^2=0.01$, $df=1$, $P>0.05$) between the academic survival status of the two groups of Batch II.

Table 3.2.5. Survival estimates of Batch III

Semester j	Survival Estimates	Standard Errors
1	0.9342	0.0164
2	0.8772	0.0217
3	0.8377	0.0244
4	0.8114	0.0259
5	0.7939	0.0268

From table 3.2.5 the probability that a student of Batch III to survive the second year was about 88%. While at the end of the fifth semester it declined to 79%. These estimates are displayed in Figure 3.2.5.

Table 3.2.6. Students' survival estimates by sex for Batch III

Semester j	Male		Female	
	Survival Estimates	Standard Errors	Survival Estimates	Standard Errors
1	0.9416	0.0189	0.9189	0.0317
2	0.8896	0.0253	0.8514	0.0414
3	0.8506	0.0287	0.8108	0.0455
4	0.8247	0.0306	0.7838	0.0479
5	0.8052	0.0319	0.7703	0.0489

As can be seen from Table 3.2.6 or Figure 3.2.6 about 81% and 77% of male and female students survived five semesters, respectively. From the result of the log-rank statistic we can conclude that there is no significant difference ($\chi^2=0.41$, $df=1$, $P>0.05$) between male and female students of Batch III with respect to their academic survival status.

From Table 3.2.7 or Figure 3.2.7 it can be seen that about 84% of the students survived five semesters with standard error 0.0210.

Table 3.2.7. Survival estimates of Batch IV

Semester j	Survival	Standard
	Estimates	Errors
1	0.9437	0.0133
2	0.9106	0.0164
3	0.8841	0.0184
4	0.8609	0.0199
5	0.8411	0.0210

Table 3.2.8. Students' survival estimates by sex for Batch IV

Semester j	Male		Female	
	Survival	Standard	Survival	Standard
	Estimates	Errors	Estimates	Errors
1	0.9583	0.0136	0.9070	0.0313
2	0.9259	0.0178	0.8721	0.0360
3	0.8981	0.0206	0.8488	0.0386
4	0.8796	0.0221	0.8140	0.0420
5	0.8565	0.0239	0.8023	0.0429

For Batch IV the probability that a male student to survive five semesters was about 86% while the figure for female students is 80%. These estimates are displayed in Figure 3.2.8. Based on the result of the log-rank statistic we can conclude that there is no significant difference ($\chi^2=1.49, df=1, P>0.05$) between the academic survival status of male and female students.

From Table 3.2.9 below or Figure 3.2.9 it can be observed that approximately 88% (with standard error 0.0172) of the students survived five semesters.

Table 3.2.9. Survival estimates of Batch V

Semester j	Survival Estimates	Standard Errors
1	0.9626	0.0106
2	0.9346	0.0138
3	0.9128	0.0157
4	0.8941	0.0172
5	0.8785	0.0182

As it can be observed from Table 3.2.10 or Figure 3.2.10 for Batch V the probabilities for male and female students to survive five semesters were about 90% and 83%, respectively.

Table 3.2.10. Students' survival estimates by sex for Batch V

Semester j	Male		Female	
	Survival	Standard	Survival	Standard
	Estimates	Errors	Estimates	Errors
1	0.9692	0.0115	0.9468	0.0231
2	0.9515	0.0143	0.8936	0.0318
3	0.9295	0.0170	0.8723	0.0344
4	0.9163	0.0184	0.8404	0.0378
5	0.8987	0.0200	0.8298	0.0388

Based on the result of the log-rank statistic we can conclude that there is no significant difference ($\chi^2=3.07$, $df=1, P>0.05$) between the academic survival status of male and female students.

Chapter Four

Discussion and Recommendation

4.1 Discussion

In this study attempts were made to model the attrition rate of students at the Faculty of Business and Economics (FBE), Addis Ababa University, to demonstrate the magnitude and pattern of academic survival rates and to compare the academic survival status of five batches male and female students. The results of the analysis are discussed in this chapter in accordance with the objective stated in Chapter one.

From the result of Section 3.1 we observed that there is no significant difference between the observed attrition rate and the estimated attrition rate obtained using Model A, B and D for the five batches. However, Model C is found to be inadequate for our data. That is why the difference between the observed and estimated attrition rate obtained from Model C was quite large. Based on these result we can conclude that the two models, A and B that are suggested by Guttman and Olkin (1989) and the reparametrized model (Temesgen, 1991) alternatively used to fit the attrition rate of students' at FBE.

As it can be seen from section 3.2, approximately 67% of the students of Batch I admitted to the FBE were able to complete the five semesters and this figure increased to 88% for Batch V. The reason for the increment of survival rates from batch to batch is probably because most of the students that are admitted FBE had high CGPAs during the first year.

The comparison of the survival estimates over the five semesters by sex revealed that there is no significant difference between the academic survival status of male and female students for the five batches. Here it should be noted that while the overall academic survival rate between the two groups were high, still the rate for female students was a little bit lower than for male students.

4.2 Recommendation

Although as Miller (1974) reminds us "leaving the university doesn't imply strictly wastage", the magnitude of the wastage problem demands remedial measures of some kind.

According to the findings of Yusuf O. et al. (1989) a great number of students who discontinue their university level education is due to academic reasons while a few dropouts because of non-academic causes. Even though the

attrition rate of students at FBE is not high, the following suggestions may help to reduce the rate of attrition not only at FBE but also at other faculties.

- i) Design an appropriate method of recruitment and allocation of students to different faculties and departments.
- ii) Special attention must be given to the task of students advising in order to help integrate them both socially and academically into the university environment.
- iii) Faculties might identify the needs and characteristics of students and modify their own procedures and environment to reduce attrition.
- iv) The teaching method at secondary schools should be designed to challenge students and motivate them to prepare adequately for college studies.

Therefore, the present study is important in the following ways: First it provides alternative models that can be used to represent the attrition rate of students at FBE. Secondly, it provides information about the academic survival rates of male and female students of FBE. Finally, it is hoped that the study will contribute to the area of educational research.

Appendix I: Table of observed attrition rates

Table 1. Observed attrition rates of students by batch

Batch	Semester				
	1	2	3	4	5
I	0.1236	0.0809	0.0780	0.0545	0.0262
II	0.0841	0.0670	0.0580	0.0388	0.0249
III	0.0658	0.0542	0.0377	0.0259	0.0152
IV	0.0563	0.0340	0.0271	0.0238	0.0199
V	0.0374	0.0284	0.0219	0.0189	0.0146

Table 2. Observed attrition rates of male students by batch

Batch	Semester				
	1	2	3	4	5
I	0.1152	0.0750	0.0725	0.0504	0.0337
II	0.0775	0.0672	0.0714	0.0512	0.0405
III	0.0584	0.0552	0.0434	0.0302	0.0208
IV	0.0417	0.0338	0.0300	0.0206	0.0263
V	0.0310	0.0183	0.0233	0.0143	0.0193

Table 3. Observed attrition rates of female students by batch

Batch	Semester				
	1	2	3	4	5
I	0.1438	0.0967	0.0958	0.0693	0.0476
II	0.0941	0.0779	0.0575	0.0406	0.0318
III	0.0811	0.0735	0.0486	0.0340	0.0235
IV	0.0930	0.0385	0.0267	0.0411	0.0143
V	0.0526	0.0556	0.0235	0.0361	0.0125

Appendix II: Survivor and hazard functions of students

Batch I

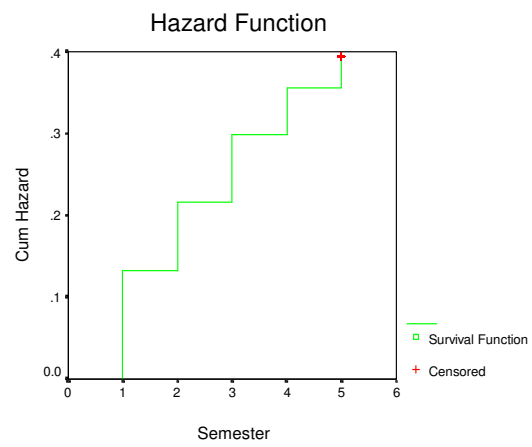
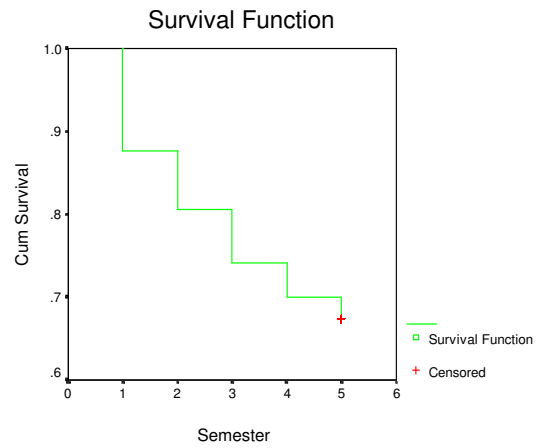


Figure 3.2.1

Batch II

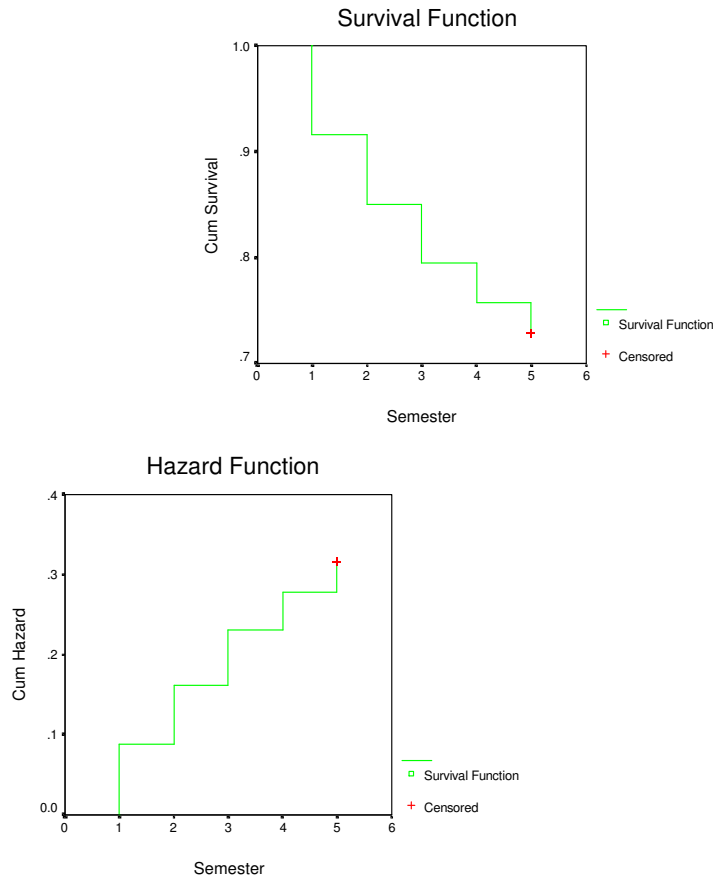


Figure 3.2.3

Batch III

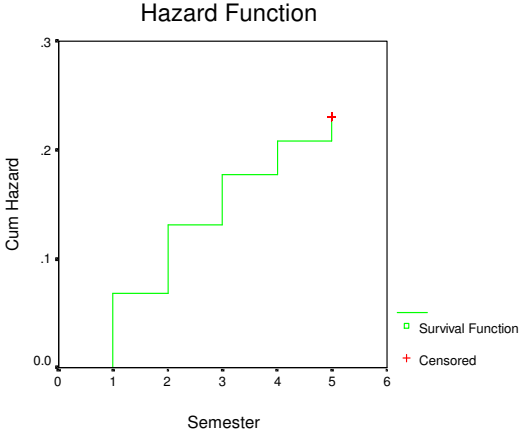
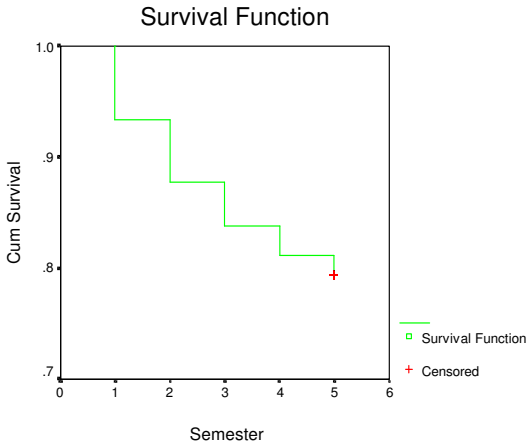


Figure 3.2.5

Batch IV

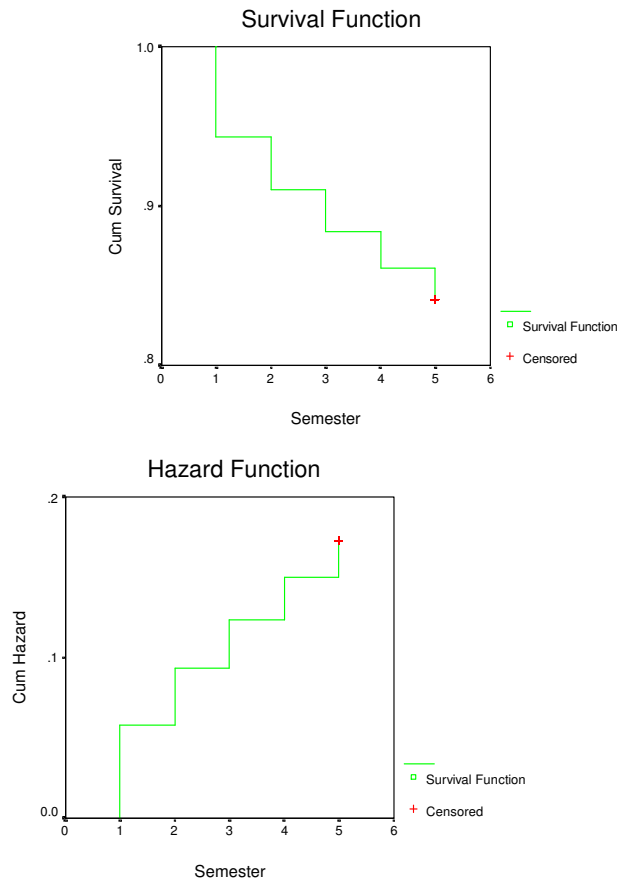


Figure 3.2.7

Batch V

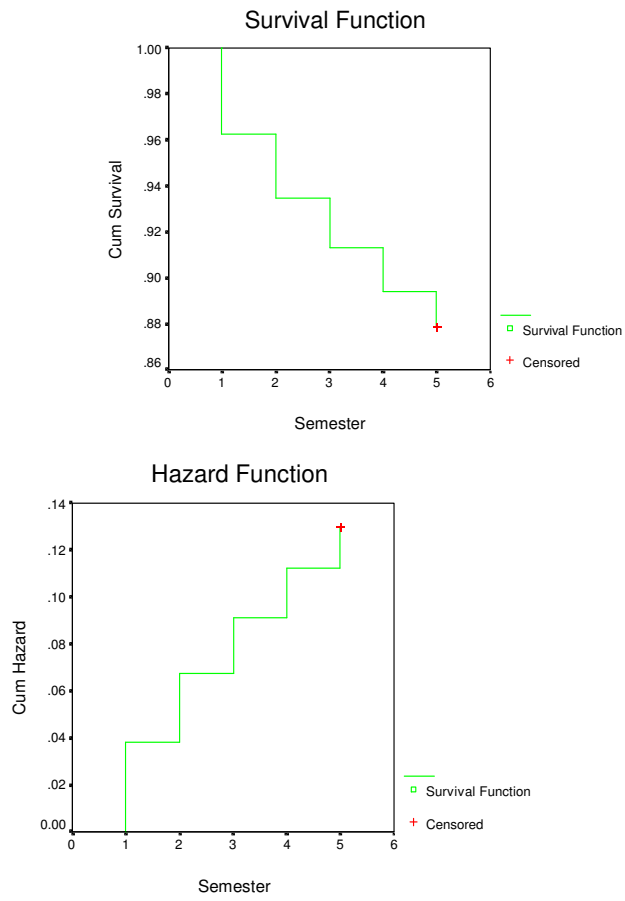


Figure 3.2.9

Appendix III: Survivor & hazard functions of students by sex

Batch I

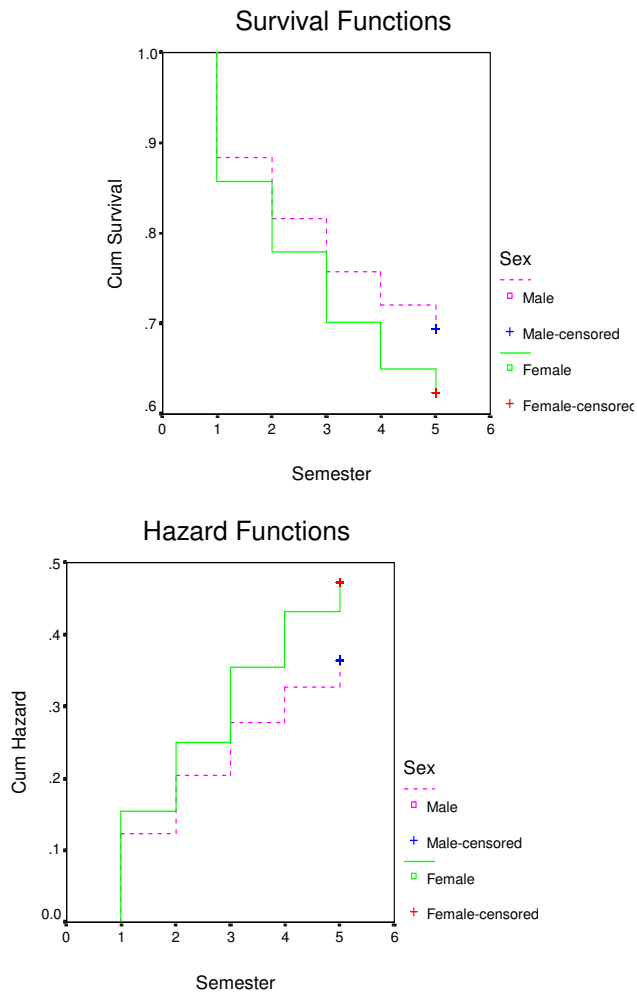


Figure 3.2.2

Batch II

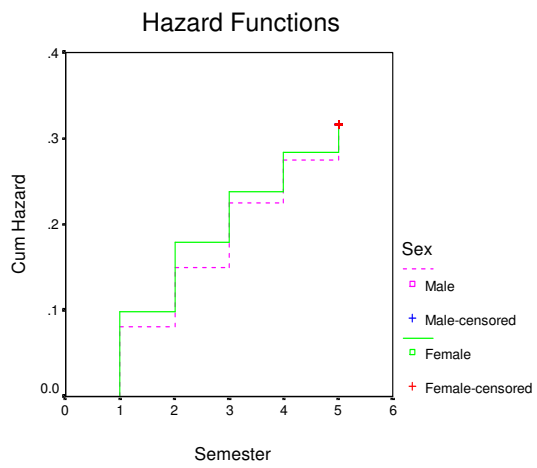
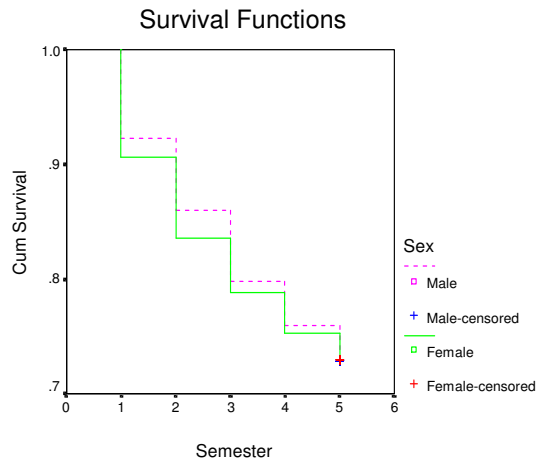


Figure 3.2.4

Batch III

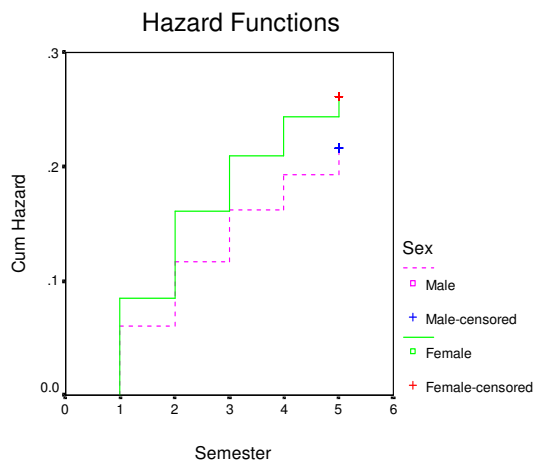
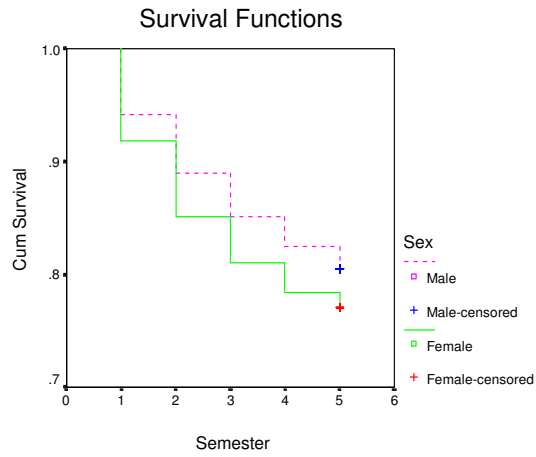


Figure 3.2.6

Batch IV

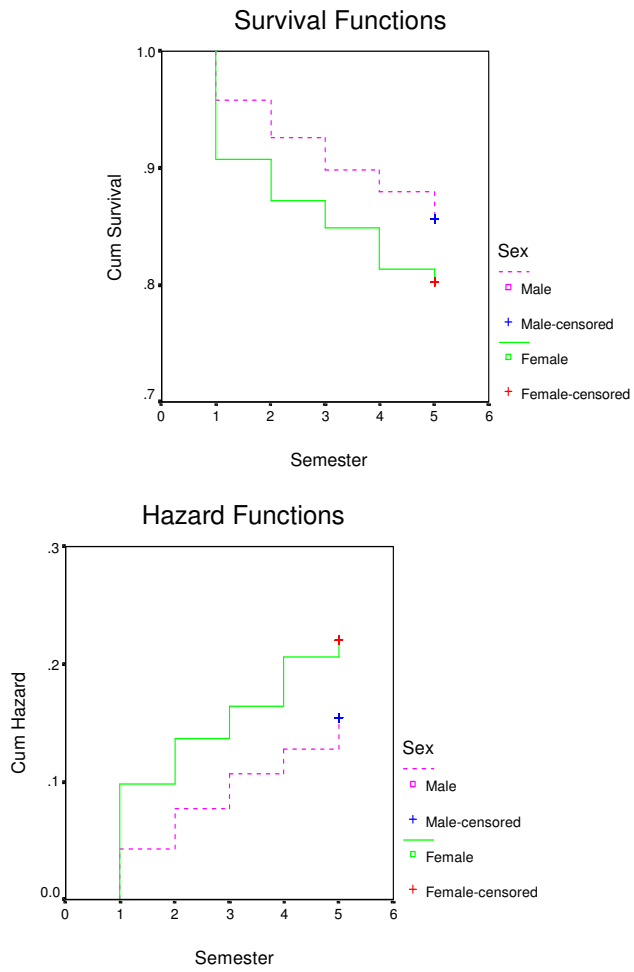


Figure 3.2.8

Batch V

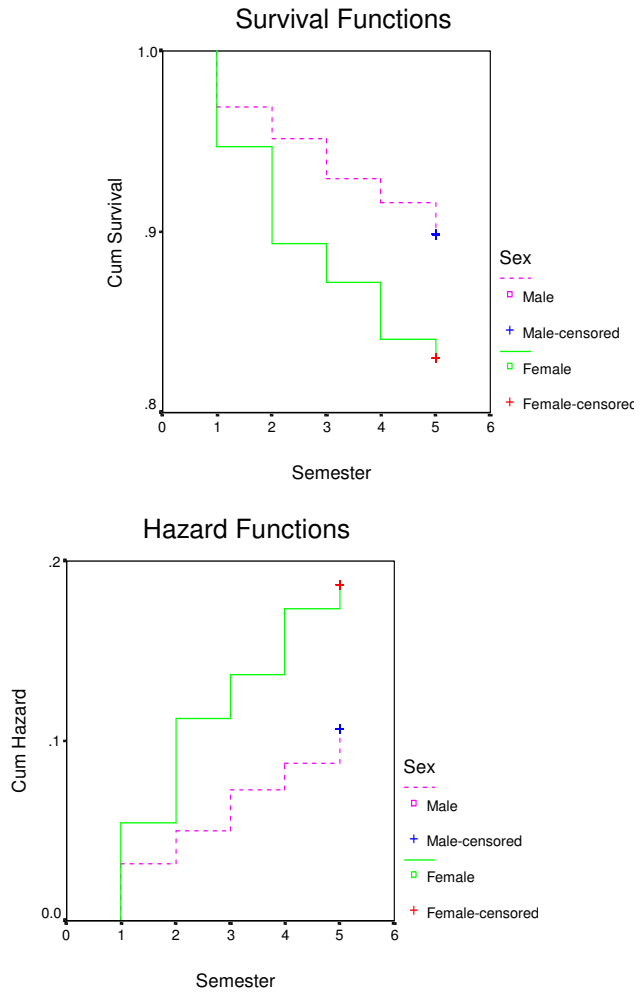


Figure 3.2.10