A Study of Some Selected Factors Affecting Academic Performance of Students at Kotebe College of Teacher Education

A Thesis

Presented to the

School of Graduate Studies

Addis Ababa University

In Partial Fulfillment of the

Requirements of the Degree of Master of Science

in Statistics

By

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June, 1999

Adds Ababa University
School of Graduate Studies

Title of Research: A Study of Some Selected Factors Affecting Academic Performance of Students at Kotebe College of Teacher Education

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ACKNOWLEDGMENT

I am indebted to my advisor, Dr. Eshetu Wencheko, who spent his valuable time on guiding, offering comments and suggestions that led to significant improvements at every stage of the study.

My thanks are also due to my colleagues at Kotebe College of Teacher Education, Department of Mathematics; to my friends for their assistance of various kinds. Particular greatest gratitude is also due to my friend Bethelihem Edeo for her continuous moral support.

In preparing the typescript my greatest debt is to W/t Nitsuhe Haileab who patiently went through innumerable drafts and revisions.

ABSTRACT

This study attempts to assess the predictive validity of some selected variables on students past experience, identification, parental economic and educational backgrounds and college facilities. It investigates the most dominant predictors of the first year first semester average score of students at Kotebe College of Teacher Education. Subjects of the study consist of 102 randomly selected freshman students from the Natural and Social Science students who were admitted to the college in the year 1998/99. Preliminary analysis is carried out through Chi-square tests and correlation analysis. The combined effect of the variables is analyzed using stepwise regression analysis. The results show that high school overall average score, age, sex, ESLCE mathematics grade, region high school attended and mother's education are significant predictors of first year first semester average score. Implications are discussed and suggestions are given.

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CHAPTER I

Introduction

1.1 Background of the Study

Education can be considered as an important social objective of any society. The role it plays and its possible contribution to the intellectual growth and development of the society have become points of common concern in both developed and developing countries (Harbison and Hanushek, 1992). The quality of educational system of any country may reflect the progress attempts that are made in social, economic and political aspects by that country.

The major problem of most developing countries like Ethiopia is a scarcity of qualified, certified and college and/or university trained people. Establishing college and/or university training may be taken as one of the solutions in tackling the problem. The common approach to the maximization of training is, however, to carefully screen students for admission to college and/or university, and to admit only those who are most likely to complete their studies (King and King, 1972).

In Ethiopia the Ethiopian School Leaving Certificate Examination (ESLCE) is used as the selection criterion of students for admission into institutes of higher education. In the past, many research works (Melaku (1975); Mekonnen (1987); Marhatibeb (1993); Asmerom, et al (1989) and King and King (1972)) evaluated the predictive power of the ESLCE along with some selected variables. However, they came out with conflicting conclusions which may suggest that further research works would be required to assess the predictive power

of the ESLCE. And also so far no attempt has been made on factors affecting academic performance of students at Kotebe College of Teacher Education (KCTE). Therefore, it seems reasonable, at this level, that if some other selected variables other than the ESLCE are examined and the influence that they might have on the academic performance of students at college level are investigated.

1.2 Objective of the Study

The overall aim of the study is to investigate the most important predictors of the academic performance of freshman students at Kotebe College of Teacher Education.

More specifically, the study attempts:

- to compare the performance of the students between or among the different categories formed on the basis of the explanatory variables.
- to identify the degree of relationships among the variables under investigation.
- to select those(at least two) variables which have the most powerful influence on the academic performance of the students.
- to provide necessary suggestions and recommendations.

1.3 Desired Outcome

The desired outcome is to provide necessary empirical evidence regarding those most powerful variables selected as predictors of academic performance, thereby enabling policy makers to give an alternative thought of selection criterion of students for admission into institutes of higher education. It is expected that the suggestions and recommendations given in this study will motivate researchers to further findings of such problems.

1.4 Organization of the Study

Chapter II deals with review of related literature. Summaries of works cited in the past either in or outside of Ethiopia on academic performance or achievements of students are described.

In Chapter III methods and procedures of sampling and data collection are presented. The variables to be included in the study with their coding and designations, and methods of data analysis are also described in this Chapter.

In Chapter IV the influence of each explanatory variable on the academic performance will be examined through chi-square tests. The combined effect of the explanatory variables on the academic performance will be investigated using stepwise multiple regression analysis in this Chapter.

Finally, some valuable suggestions, recommendations and their implications will be given in Chapter V. Results are also discussed.

CHAPTER II

Literature Review

Various studies have been made and conclusions were reached by different scholars in the past regarding the predictors of academic success. Survey of available literature indicated that factors like school leaving examinations, educational background, Scholastic Aptitude Test (SAT), gender, student study behaviors are predictors of success in colleges and/or universities.

King and King (1972) have shown that proficiency in English language skills and aptitude tests were the best predictors of university grades by examining language backgrounds, educational backgrounds, and scores on a variety of achievement and aptitude tests of 1213 freshman students admitted to Haile Sellasie I University (now Addis Ababa University) in the academic year 1968/1969 through correlation analysis.

Melaku (1975) investigated the relationship between Ethiopian School Leaving Certificate Examination (ESLCE) and freshman first semester performance of 308 academically dismissed students of the 1973/74 batch of Haile Sellassie I University (HSIU) based on six selected variables: ESLCE Amharic, ESLCE English, ESLCE Mathematics, ESLCE composite scores (Amharic, English and Mathematics), ESLCE average scores and university first semester Grade Point Average (GPA). He has shown that the ESLCE average scores as well as the scores in Amharic or English or Mathematics were not predictors of university performance of the dismissed students.

Mekonnen (1987), in his project on ranking and selection procedures and their application to the educational performance of students at Addis Ababa University (AAU), has shown

that the grade point average in ESLCE cannot stand alone as the sole selection criterion for admission of students to the University. He has also shown that those students who took ESLCE only once have better performance than those who took more than once, and ESLCE Mathematics grade is the best predictor of success in the Faculty of Science.

The influence of GPA of ESLCE and some selected factors on first year first semester GPA of science students admitted to AAU in the academic year 1987/88 was assessed by Habte (1988). Through regression analysis he examined the effects of fifteen selected variables on freshman students' academic performance, and he concluded that a log transform of first semester freshman GPA and a similar transform of the ESLCE GPA have a strong linear relationship. Moreover, he has shown that dormitory facility has positive impact on the performance of the students.

Asmerom, et al (1989) conducted a study on 293 dropout and withdrawal students from the various faculties and colleges of AAU and College of Agriculture (now called Alemaya Agricultural University) to estimate the number of dropouts and withdrawals, and also to identify the causes. Their findings indicated that students with good performance in the ESLCE tend to have good performance in the first year first semester. The study revealed that students admitted to the Faculties of Science, Medicine, Technology and College of Agriculture seem to perform poorly as compared to those admitted to the College of Social Science. They also showed that ESLCE mathematics result is not a predictor of success in the first year first semester mathematics. It was also shown that ESLCE English result predicts success in first year first semester English in the Faculty of Social Science but not in the Faculty of Natural Science.

A stepwise multiple regression analysis was employed to examine the relationship of students study behaviors and academic achievement by Whilhite (1990). He used a sample of 184 students enrolled in an introductory Psychology course. He found that scores on a self assessment measure of memory ability (everyday memory questionnaire) were the best predictors of final course grades, followed by scores on a locus of control measure and scores on self-concept of Academic Ability Test.

The influence of some selected factors on the academic performance of students at AAU was examined by Fentaw (1991). He used Wilks' stepwise variable selection procedure and selected eleven and nine best variables which affect the academic performance of students in the Faculty of Social Science and Faculty of Science, respectively. Moreover, through profile analysis he came to the conclusion that students from different types of schools have similar trend of academic achievement.

Bouillon and Doran (1992) compared the performance of female and male students at Iowa State University in Accounting Principles I and II using multiple regression techniques to assess the incremental explanatory effects of gender. They investigated that male students significantly outperformed female students in Accounting Principles I. Moreover, the performance of the two groups was not found to be significantly different in Accounting Principles II. By controlling some variables they also showed that the performance of male students is slightly better than that of female students in Accounting Principles II.

Marhatibeb (1993) carried out a study to find out the relationship among seven selected variables: ESLCE GPA, ESLCE English grade, ESLCE Mathematics grade, freshman first semester GPA, Cumulative GPA at graduation or dismissal, first year first semester English grade and first year first semester Mathematics grade with regard to regular

diploma students who either graduated or discontinued their study for academic reasons from Bahir Dar Teachers College in the academic years 1987/88 to 1991/92. He confirmed that grades scored in the College are consistent whereas the ESLCE variables have weak relations either among themselves or with the scores earned in the College by making use of correlation analysis.

As cited in the work of Laekemariam (1994) the pre-college examination score (administrated right after registration) is the best predictor of first year first semester college performance of students of Wondo Genet College of Forestry (WGCF) in the 1992/93 and 1993/94 academic years. He has also shown that the high school achievements considered in grades 11 and 12 is the second best predictor of college performance and that ESLCE GPA has poor predictive power of freshman first semester GPA.

The extent to which a student's mathematics background determines performance in Micro - and Macro-economics courses was examined by Petrowsky (1994). The subjects of his study were 156 students of Economic Principles classes. Their high school educational backgrounds in mathematics, scores on mathematics placement examinations and college mathematics scores were subjected to the analysis of variance against students final term averages in Micro- and Macro- economics courses. He found that there is no relationship between the high school mathematics background and the final averages in economics courses.

A study based on SAT, average grade earned in high school, and 32 personality variables was made by Wolfe and Johnson (1995) to identify the best predictors of GPA. Their study was based on a sample of 201 Psychology students at the State University of New York. Results from the Forward Multiple Regression Analysis revealed that average grade

earned in the high school, self-control and SAT are the best predictors of GPA accounting for 19%, 9% and 5% of the variance in GPA, respectively.

The study by Fantu, et al (1996) that was based on a sample of 256 randomly selected freshman students admitted to different faculties of AAU and Alemaya Agricultural University in the academic year 1991/92 revealed that the SAT and high school academic rank have statistically significant effects on freshman GPA.

Through multiple regression analysis, Harrison (1996) has shown that years of performance experience is the only statistically significant predictor of grades in a music theory course for 279 nonmusic major students at California State University. This variable accounted for 10% of the variation in music theory grades. However, the variables on measures of musical aptitude test and sex did hardly predict music theory grades.

From the reviews of related literature cited above, factors on educational backgrounds of students, SAT and student study behaviors have greater impacts on academic performance of the students at colleges and/or universities in and outside of Ethiopia. However, so far no attempt has been made in this area on students admitted to Kotebe College of Teacher Education (KCTE). Thus, the present study tries to investigate some potential factors affecting academic performance of students at KCTE.

CHAPTER III

Methods and Procedures

In this Chapter methods and procedures of sampling and data collection are discussed. The variables to be included in the study are described. Variable coding and designation, and methods of data analysis are also entertained.

3.1 The Sample

All freshman degree students admitted to Kotebe College of Teacher Education (KCTE) in the academic year 1998/99 constituted the sampled population. Two groups of students were considered: Natural Science students and Social Science students. In this study a random sample of size 102 was used. The sample size is decided by making use of the general principle cited in Draper and Smith (1981, p. 417). That is, we think there should be about ten complete sets of observations for each potential variable to be included in the model; for instance, if it is believed that the final practical predictive model should have four x-variables plus a constant, then there should be at least forty sets of observations ($n = 40$). Using the stratified sampling procedures simple random samples of sizes 61 and 41 were obtained from the Science and Social Science groups, respectively.

3.2 Procedures of Data Collection and Sources of Data

Three sources of data were used: the students, the instructors and students' personal files. Data on high school academic achievements were obtained from students' personal files available in the Record Office of the College. That is, scores in English, scores in Mathematics and average scores for grades 9 - 12 were obtained from the transcript of each student in his/her file. Results based on ESLCE performance like the ESLCE grade point

average, ESLCE English grade and ESLCE Mathematics grade were also obtained from the students' personal files.

Students pursuing the degree programme were registered for six courses in the semester. That is, Natural Science students were registered for Mathematics, English, Physics, Chemistry, Biology and Physical Education and Social Science students were registered for Mathematics, English, Geography, Philosophy, Psychology and Physical Education. Raw scores achieved by the students on each course were collected from the respective instructors of the courses at the end of the semester.

A questionnaire form on identification variables, economic and educational backgrounds of the parents, college facilities and some other selected variables was prepared and distributed to the sample students (n = 102). They were requested to fill in and return the completed questionnaire within three days. Surprisingly all students handed in the completed questionnaire form on time. However, almost all the students were not willing to indicate their ethnic group. Thus, this variable was left out from the study. For the remaining variables in the questionnaire form, expected answers were provided by the students. The detailed information about the questionnaire is given in Appendix I.

3.3 Variables Included in the Study

How variables are specified and how accurately they are measured influence the interpretation of results. Therefore, definitions or specifications and/or designations of the variables are given below.

A method of dummy coding is used for variables having two levels, that is, 0 - 1 coding is employed as indicated in Draper and Smith (1981).

x_{01} = sex (= 1 if male; 0 if female)

Sex of students can be considered as one of the explanatory variables. This is due to the belief that boys and girls in developing countries like Ethiopia are given different expectations in the society. These expectations may influence their motivations, and therefore, they may develop different kinds of skills and abilities.

x_{02} = age up on admission (in complete years).

x_{03} = place high school was attended (= 1 if Addis Ababa; 0 if not)

The educational environment of schools in Addis Ababa is relatively different from schools in the other regions due to the concentration of experienced teachers and that provision of school facilities are relatively better.

x_{04} = school type (= 1 if government; 0 if not)

To some extent prior performance of students tend to be related to their college performance. For the purpose of this study three variables on high school achievement are considered. These are

x_{05} = high school English score (an average of scores in English for grades 9 - 12)

x_{06} = high school mathematics score (an average of scores in mathematics for grades 9 - 12), and

x_{07} = high school overall average score (a weighted average of average scores for grades 9, 10, 11 and 12). Weight refers to the number of courses that the student had taken in each grade level.

The ESLCE is a school leaving examination that has been put into use for many years. Ever since it has always been administered by the Ministry of Education. It has been used as a selection criterion for admission of students into higher education and teacher training institutions. Therefore, results of ESLCE may tend to influence college success. So the following ESLCE variables are considered in the study.

x_{08} = ESLCE English grade (numerical substitutes 4, 3, 2, 1 and 0 for letter grades A, B, C, D and F, respectively)

x_{09} = ESLCE Mathematics grade (numerical substitutes 4, 3, 2, 1 and 0 for letter grades A, B, C, D and F, respectively)

x_{10} = ESLCE GPA (an average of grades in five subjects: Mathematics, English and three other subjects on which the students had relatively better results).

The levels of mother's education and father's education contribute positively or negatively or even may have no significance on the academic performance of their child/children. Therefore,

x_{11} = education of the father (=1 if literate; 0 otherwise), and

x_{12} = education of the mother (=1 if literate; 0 otherwise)

are considered as additional explanatory variables.

x_{13} = economic status of the parents (= 1 if monthly income $\geq$ 201 Birr/month ; 0 if monthly income < 201 Birr/month).

The economic status of the parents to some extent, relates to academic performance of the students. With regard to this, students were requested to identify the categories into which

their parents average monthly income in Birr falls. Two categories were formed: those whose parents average monthly income was below the urban poverty line which was Birr 201 per month for a family of five persons (MOPED, 1992: 20) and those with average monthly income equal to or above this poverty line.

One intervention that has widespread endorsement, although as much as conceptual reasons as for solid empirical ones, is the provision of textbooks (Harbison and Hanushek, 1992) and written materials. The relationship of textbooks to students' performance is found to be important. The availability of written materials or textbooks may have impact on students' performance. The provision of dormitory with necessary facilities provides the creation of good educational environment for the students. Students who were provided with textbooks (written materials) and dormitory with necessary facilities are expected to perform better, and improved facilities are systematically beneficial to students' learning. So, the next two variables are on the provision of textbooks and dormitory.

x_{14} = textbook (= 1 if provided for at least one course; 0 if not provided for all courses.)

x_{15} = dormitory (= 1 if provided with necessary facilities; 0 if not provided with necessary facilities).

Regardless of how it would be measured, the degree of frustration caused by fear of academic dismissal due to lack of confidence, the competitive nature of the college life and the like may influence the academic performance of students. Responses of students on whether or not they have been frustrated by fear of academic dismissal are collected. The variable with regard to this is described below.

x_{16} = frustration caused by fear of academic dismissal

(=1 if frustrated; 0 otherwise)

And finally the two categories of students were coded as

x_{17} = group type (= 1 if Natural Science; 0 if Social Science)

Academic quality can be defined as performance on Grade Point Average or average of raw scores achieved by the students. The criterion(response) variable is the performance of freshman students in the first semester. Here by performance we mean the weighted average of raw scores that were achieved by the students in the examinations of the courses they were registered for. Weight refers to the credit number of the course.

The criterion (response) variable is designated by **y** and it is first year first semester average score (semester grade point average).

3.4 Methods Employed for Data Analysis

The utilization of different methods of data analysis provides extra information about the consistency and reliability of any specific findings. So, in this study, to see the general feature of the data on each variable, descriptive statistics like the mean, standard deviation and coefficient of variation of each variable were calculated. The chi-square tests were also performed in the preliminary analysis. The investigation of the relationships of the explanatory variables either among themselves or with the criterion variable was performed using correlation analysis.

The combined effect of the explanatory variables on the response variable was examined using multiple regression analysis. A regression equation was fitted for all observations and a stepwise regression analysis was employed to determine the best predictors of the response variable.

Residual analysis was performed to check the validation of the model assumptions. Plots of residuals against predicted values and normal probability plot were examined. These procedures are discussed in detail in Montgomery and Peck (1992), Weisberg (1985), Cook and Weisberg (1982).

CHAPTER IV

Results and Data Analysis

4.1 The Preliminary Analysis

The variables under investigation were analyzed with SPSS/PC+ statistics packages. Non-parametric tests(chi-square tests) were carried out to check if there is a difference in academic performance between or among the categories that were formed for each explanatory variable.

4.1.1 Chi-Square Tests

Group Type and Academic Performance

To test the hypothesis that the two groups (natural science and social science students) are homogeneous with regard to academic performance, students were categorized into three groups (below satisfactory, satisfactory and above satisfactory). That is, students with average scores (y) below 60 were categorized into the below satisfactory group; those with average scores (y) greater or equal 60 but less than 80 were categorized into the satisfactory group while those with average scores (y) greater than or equal to 80 were categorized into the above satisfactory group. Table 4.1.1 shows the distribution of students in the three academic performance groups.

Table 4.1.1 Group type and academic performance

Group Type	Academic Performance		
	Below Satisfactory	Satisfactory	Above Satisfactory
Natural Science	29	24	8
Social Science	31	9	1

The chi - square test ($x^2 = 8.744$, df $= 2$, $\alpha < 0.05$) indicates that the two groups are not identical with respect to academic performance. Therefore, the effect of each variable on academic performance is investigated for social science, natural science and combined students hereafter.

Sex of Students and Academic Performance

The data were subjected to chi-square test to check whether or not the sex of the students is significantly related to academic performance. Table 4.1.2 shows the distribution of students according to their sex and the three academic performance groups (below satisfactory, satisfactory and above satisfactory). The chi-square tests ($x^2 = 2.792$, df $= 2$ for natural science and $x^2 = 1.837$, df $= 2$ for social science and $x^2 = 1.611$, df $= 2$ for combined at 0.05 level) indicate that there is no significant difference between male and female students for the three groups.

Table 4.1.2 Sex and academic performance

Academic Performance	Natural Science		Social Science		Combined	
	Male	Female	Male	Female	Male	Female
Below Satisfactory	21	8	20	11	41	19
Satisfactory	18	6	5	14	23	10
Above Satisfactory	8	0	0	1	8	1
Total	47	14	25	16	72	30

Age and Academic Performance

To test whether or not there is a significant difference in academic performance with regard to age of the students, two age groups were formed. Students with age less than 19 years (coded as "1") were categorized as group I and all others (coded as "0") were categorized as group II. Table 4.1.3 shows the distribution of students in the two groups with regard to the academic performance groups. The chi-square tests ($x^2 = 0.289$, df $= 2$ for natural science; $x^2 = 2.668$, df $= 2$ for social science and $x^2 = 1.283$ df $= 2$ for combined at

$\alpha = 0.05$ level of significance) reveal that there is no significant difference between the two age groups with regard to the three academic performance groups.

Table 4.1.3 Age and Academic Performance

	Natural Science		Social Science		Combined	
Academic Performance	1	0	1	0	1	0
Below Satisfactory	10	19	8	23	18	42
Satisfactory	10	14	3	6	13	20
Above Satisfactory	3	5	1	0	4	5
Total	23	38	12	29	35	67

Place high school was attended and Academic Performance

As indicated in the variable description student's region was categorized as Addis Ababa (coded as "1") and non-Addis Ababa (code as "0"). The distribution of students according to these categories and the academic performance groups for the combined, social science and natural science students is given in Table 4.1.4.

Table 4.1.4 Place high school attended and academic performance

	Natural Science		Social Science		Combined	
Academic Performance	1	0	1	0	1	0
Below Satisfactory	3	26	7	24	10	50
Satisfactory	12	12	3	6	15	18
Above Satisfactory	2	6	1	0	3	6
Total	17	44	11	30	28	74

The chi-square tests ($x^2 = 10.311$, df =2 for natural science and $x^2 = 3.206$, df = 2 for social science and $x^2 = 9.031$, df = 2 for combined at $\alpha = 0.05$ level of significance) indicate that there is a significant difference between students from Addis Ababa and students from the other regions for the natural science group and the combined group, but

there is no significant difference for the social science group with regard to the academic performance.

School Types and Academic Performance

On the basis of types of schools where high school was attended students were categorized into two. Those who attended their high school education at government schools (code as "1") and non-government schools (coded as "0") form the two categories. The distribution of students in these school types with regard to the three academic performance groups is presented in Table 4.1.5. The chi-square tests ($x^2 = 2.219$, df = 2 for natural science; $x^2 = 6.082$, df = 2 for social science and $x^2 = 0.585$, df = 2 for combined at $\alpha = 0.05$ level of significance) reveal that there is no significant difference in performance between the two school types for natural science students and the combined group while there is a significant difference in performance between the two school types for social science students.

Table 4.1.5 School Types and Academic Performance

	Natural Science		Social Science		Combined	
Academic Performance	1	0	1	0	1	0
Below Satisfactory	24	5	27	4	51	9
Satisfactory	23	1	6	3	29	4
Above Satisfactory	7	1	0	1	7	2
Total	54	7	33	8	87	15

High School English Score and Academic Performance

With regard to high school English score students were put into three categories. These are

1. Below Satisfactory (those with English score less than 60)
2. Satisfactory (those with English score greater or equal to 60 but less than 80)
3. Above Satisfactory (those with English score greater or equal to 80)

The categorized data were subjected to the chi-square tests against the academic performance groups for natural science, social science and the combined students. The analysis ($x^2 = 23.434$, df = 4 for natural science; $x^2 = 6.141$, df = 4 for social science and $x^2 = 28.037$, df = 4 for the combined at $\alpha = 0.05$ level of significance) reveals that there is a significant difference in performance among the three categories for the natural science and the combined students. But there is no statistically significant difference in performance among the categories for the social science students. The distribution of students in the three categories with regard to the academic performance groups for the natural science, social science and combined students is given in Table 4.1.6.

Table 4.1.6 High School English Score and Academic Performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	10	14	5	8	18	5	18	32	10
Satisfactory	1	10	13	0	9	0	1	19	13
Above Satisfactory	0	0	8	0	1	0	0	1	8
Total	11	24	26	8	28	5	19	52	31

High School Mathematics Score and Academic Performance

Students were categorized as below satisfactory (1), satisfactory (2) and above satisfactory (3) groups as in the case of English score given above. Table 4.1.7 shows the distribution of students in these categories for natural science, social science and combined students. The chi-square tests ($x^2 = 31.727$, df = 4 for natural science, $x^2 = 6.796$, df = 4 for social science and $x^2 = 50.173$, df = 4 for combined students at $\alpha = 0.05$ level of significance). The categorized groups were significantly different for natural science and combined students in performance while there is no significant difference in performance for social science students.

Table 4.1.7 High School Mathematics Score and Academic performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	12	15	2	8	18	5	20	33	7
Satisfactory	1	11	12	0	9	0	1	20	12
Above Satisfactory	0	0	8	0	1	0	0	1	8
Total	13	26	22	8	28	5	21	54	27

High School Overall Average Score and Academic Performance

Students were categorized as below satisfactory (1), satisfactory (2) and above satisfactory (3) groups on the basis of overall average score that they received in high school. That is, students with overall average scores less than 60, greater or equal to 60 but less than 80, and greater or equal to 80 were categorized into below satisfactory, satisfactory, and above satisfactory groups, respectively. Table 4.1.8 shows the distribution of students in high school overall average score and college academic performance. The chi-square tests ($x^2 = 39.945$, df = 4 for natural science; $x^2 = 23.806$, df = 4 for social science and $x^2 = 61.06$, df = 4 for combined at $\alpha = .05$ level) show that there is a significant difference in performance between the three categories.

Table 4.1.8 High School overall average Score and Academic Performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	15	14	0	9	21	1	24	35	1
Satisfactory	2	17	5	0	9	0	2	26	5
Above Satisfactory	0	1	7	0	0	1	0	1	8
Total	17	32	12	9	30	2	26	62	14

ESLCE English Grades and Academic Performance

ESLCE English grade was used to categorize students into three groups. That is, those with A grade were put in group 1; those with B grade in group 2 and all others in group 3. These three groups were subjected to chi-square tests against the three academic performance groups for natural science, social science and combined students, separately. The analysis ($x^2 = 1.843$, df = 4; $x^2 = 5.083$, df = 4 and $x^2 = 5.600$, df = 4 for social science, natural science and combined students at $\alpha = 0.05$ level of significance, respectively) reveals that there is no significant difference in performance among the three categories for each group. Table 4.1.9 shows the distribution of students in the three categories with regard to their academic performance.

Table 4.1.9 English ESLCE Grade and Academic Performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	18	10	1	22	8	1	40	18	2
Satisfactory	17	7	0	5	4	0	22	11	0
Above Satisfactory	8	0	0	1	0	0	9	0	0
Total	43	17	1	28	12	1	71	29	2

ESLCE Mathematics Grade and Academic Performance

Those students with grade A or B, C, and D or F were categorized into groups 1, 2, and 3, respectively. The chi-square tests ($x^2 = 19.907$, df = 4 for natural science; $x^2 = 5.201$, df = 4 for social science and $x^2 = 36.212$, df = 4 for combined at $\alpha = 0.05$ level of significance) show that there is a significant difference in performance among the groups for natural science and combined students. But there is no significant difference in performance among the groups for social science students. Table 4.1.10 shows the distribution of students in these groups with regard to the academic performance.

Table 4.1.10 ESLCE Mathematics Grades and Academic Performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	0	21	8	6	24	1	0	27	33
Satisfactory	5	16	3	5	4	0	5	21	7
Above Satisfactory	5	3	0	0	1	0	5	3	1
Total	10	40	11	11	29	1	10	51	41

ESLCE GPA and Academic Performance

Students were grouped into three on the basis of their ESLCE GPA.

Group 1: those with GPA ≥ 3.8

Group 2: those with GPA $= 3.4$ or 3.6

Group 3: those with GPA $= 3.2$

Table 4.1.11 shows the distribution of students in these three groups along with the academic performance groups. The chi-square tests ($x^2 = 36.176$, df = 4 for natural science; $x^2 = 41.22$, df = 4 for social science and $x^2 = 57.507$, df = 4 for combined at $\alpha = 0.05$ level of significance) show that there is a significant difference in performance among the three groups.

Table 4.1.11 ESLCE GPA and Academic Performance

Academic Performance	Natural Science			Social Science			Combined		
	1	2	3	1	2	3	1	2	3
Below Satisfactory	0	17	12	0	13	18	0	30	30
Satisfactory	10	12	2	0	3	6	10	15	8
Above Satisfactory	8	0	0	1	0	0	9	0	0
Total	18	29	14	1	16	24	19	45	38

Father's Education and Academic Performance

Students were categorized into two groups according to their fathers' education. Those students whose fathers are literate were in group 1 and those with illiterate fathers are in group 2. The distribution of students in these groups is given in Table 4.1.12. The chi-square tests ($x^2 = 0.068$, df = 2 for natural science; $x^2 = 0.804$, df = 2 for social science and $x^2 = 0.003$, df = 2 for combined at $\alpha = 0.05$) show that there is no significant difference in performance between the two groups.

Table 4.1.12 Father's Education and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	2	1	2	1	2
Below Satisfactory	16	13	17	14	33	27
Satisfactory	13	11	5	4	18	15
Above Satisfactory	4	4	1	0	5	4
Total	33	28	23	18	56	46

Mother's Education and Academic Performance

Table 4.1.13 presents the distribution of students according to their mother's educational background (literate coded as "1" and illiterate coded as "0"). The chi-square tests ($x^2 = 0.685$, df = 2 for natural science; $x^2 = 1.120$, df = 2 for social science and $x^2 = 1.273$, df = 2 for combined at $\alpha = 0.05$ level) show that there is no significant difference in performance between the two groups.

Table 4.1.13 Mother's Education and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	0	1	0	1	0
Below Satisfactory	14	15	16	15	30	30
Satisfactory	11	13	4	5	15	18
Above Satisfactory	5	3	1	0	6	3
Total	30	31	21	20	51	51

Parents Economic Status and Academic Performance

Table 4.1.14 presents the distribution of students according their parents' monthly income. The chi-square tests ($x^2 = 11.92$, df = 2 for natural science; $x^2 = 1.375$, df = 2 for social science and $x^2 = 12.303$, df = 2 for combined at $\alpha = 0.05$ level) show that there is a significant difference in performance between the two groups for natural science and combined students and that there is no significant difference in performance between the two groups for social science students.

Table 4.1.14 Parents Monthly Income and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	0	1	0	1	0
Below Satisfactory	15	14	19	12	34	26
Satisfactory	21	3	7	2	28	5
Above Satisfactory	8	0	1	0	9	0
Total	44	17	27	14	71	31

Textbooks and Academic Performance

Table 4.1.15 presents the distribution of students according to whether they were provided with textbooks or not. The chi-square tests ($x^2 = 1.248$, df = 2 for natural science; $x^2 = 1.791$, df = 2 for social science and $x^2 = 0.471$, df = 2 for combined at 0.05 level) show that there is no significant difference in performance between the two categories (those who were provided coded as "1" and those who were not provided coded as "0").

Table 4.1.15 Textbooks and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	0	1	0	1	0
Below Satisfactory	15	14	11	20	26	34
Satisfactory	9	15	3	6	12	21
Above Satisfactory	3	5	1	0	4	5
Total	27	34	15	26	42	60

Dormitory Facility and Academic Performance

Table 4.1.16 presents the distribution of students according to whether or not they were provided with dormitory facilities. The chi-square tests ($x^2 = 0.163$, df = 2 for natural science; $x^2 = 1.120$, df = 2 for social science and $x^2 = 0.252$, df = 2 for combined at 0.05 level of significance) reveal that there is no significant difference in performance between those who were provided with dormitory facilities and those who were not provided.

Table 4.1.16 Dormitory Facility and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	0	1	0	1	0
Below Satisfactory	13	16	15	16	28	32
Satisfactory	12	12	5	4	17	16
Above Satisfactory	4	4	0	1	4	5
Total	29	32	20	21	49	53

Fear of Academic Dismissal and Academic Performance

Table 4.1.17 presents the distribution of students according to whether a student was frustrated by fear of academic dismissal or not. The chi-square tests ($x^2 = 3.979$, df = 2 for natural science; $x^2 = 1.823$, df = 2 for social science and $x^2 = 3.113$, df = 2 for combined at $\alpha = 0.05$ level of significance) reveal that there is no significant difference in performance between the two groups.

Table 4.1.17 Fear of Academic Dismissal and Academic Performance

Academic Performance	Natural Science		Social Science		Combined	
	1	0	1	0	1	0
Below Satisfactory	17	12	15	16	32	28
Satisfactory	9	15	3	6	12	21
Above Satisfactory	2	6	1	0	3	6
Total	28	33	19	22	47	55

4.1.2 Descriptive Measures

The means, standard deviations and coefficient of variations of the variables are presented in Table 4.1.18.

Table 4.1.18 Means, standard deviations and coefficient of variations

Variable	Mean	Standard Deviation	Coefficient of Variation
x_{01}	0.71	0.46	0.65
x_{02}	19.05	1.21	0.06
x_{03}	0.27	0.49	1.81
x_{04}	0.85	0.36	0.42
x_{05}	72.67	12.14	0.18
x_{06}	66.83	14.13	0.21
x_{07}	67.30	10.46	0.16
x_{08}	3.66	0.52	0.14
x_{09}	2.70	0.64	0.24
x_{10}	3.45	0.25	0.07
x_{11}	0.55	0.50	0.91
x_{12}	0.52	0.50	0.96
x_{13}	0.70	0.46	0.66
x_{14}	0.41	0.49	1.20
x_{15}	0.48	0.50	1.04
x_{16}	0.46	0.50	1.09
x_{17}	0.60	0.49	0.82
y	54.56	19.05	0.35

As it can be seen from the Table notable variations are observed within the variables x_{03} (place high school attended), x_{11} (mother's education), x_{12} (father's education), x_{14} (textbooks), x_{15} (dormitory facility) and x_{16} (fear of academic dismissal). These variations are clearly observable when the comparison is made between variables in terms of their coefficient of variations.

The mean corresponding to each dummy variable represents the proportion of cases in the category where the variable attains a value one. For instance, the mean of the variable x_{01} (Sex), is 0.71 which means that about 71% of the students are male and the rest are female. The same argument can be extended to the remaining dummy variables.

4.1.3 Intercorrelations Among the Variables

Bivariate correlation coefficients for the variables under investigation are presented in Table 4.1.19. Some coefficients are statistically significant at 0.01 level of significance and these significant correlation coefficients are indicated with asterisk (*).

Table 4.1.19 Bivariate Correlation Coefficients

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	Y
X2	0.2775*																	
X3	-0.2779*	-0.1533																
X4	0.3395*	0.0170	-0.2408															
X5	0.2385	-0.1344	0.1285	0.0753														
X6	0.3247*	-0.2239	0.0904	0.0504	0.7483*													
X7	0.1486	-0.0021	0.1455	-0.0935	0.6221*	0.6133*												
X8	-0.1378	-0.0681	0.1968	-0.1694	0.3407*	0.1223	02613*											
X9	0.1308	-0.1982	0.5200*	0.1492	0.2541*	0.4991*	0.2522	-0.1683										
X10	0.2508	-0.1252	0.2072	-0.0039	0.5722*	0.7051*	0.6086*	0.2261	0.5360*									
X11	-0.1094	-0.1436	0.1602	-0.0982	0.1321	0.0561	0.0147	-0.0300	0.0623	0.0740								
X12	-0.0177	-0.0589	0.1078	0.0668	-0.0117	-0.0440	0.1145	0.1215	0.1263	0.0232	-0.0827							
X13	-0.1926	-0.3106*	0.2637*	-0.1540	0.2504	0.2814*	0.3080*	0.1393	0.1529	0.3034*	0.1722	0.0473						
X14	-0.0720	-0.0176	0.0210	-0.1026	0.1213	0.0262	-0.0492	0.0934	0.0239	-0.0270	-0.0024	0.0070	-0.0535					
X15	0.1469	0.1734	0.1121	-0.0114	0.0653	0.0034	0.0331	0.1073	-0.1570	-0.0388	-0.2722*	-0.2930*	-0.1326	0.2322				
X16	-0.1371	0.0278	-0.1279	-0.1160	-0.2715*	-0.1658	-0.1579	-0.1098	-0.0529	-0.1404	0.0473	-0.0560	-0.1161	0.1458	-0.2196			
X17	0.1730	-0.1332	0.0114	0.1113	0.2642*	0.4882*	0.0859	-0.0027	0.5493*	0.5000*	0.0130	0.0122	0.0669	0.0765	-0.0122	-0.0043		
Y	0.1599	-0.3046*	0.3318*	-0.0663	0.6298*	0.7628*	0.7360*	0.2048	0.4246*	0.6541*	0.0069	-0.0231	0.3374*	-0.0733	0.0609	-0.2013	0.2058	1.00

4.2 Regression Analysis

Stepwise regression analysis was performed to select the most important factors affecting the academic performance of the students. That is, the data were subjected to the stepwise regression analysis and then the best predictors of the first year first semester average score were selected. The contribution of each of these selected predictors to the average score was also determined.

Examination of the scatter plots and normal probability plot of residuals were made to detect departures from normality, outliers, non-constant variance, and the wrong functional form. Moreover, partial regression plots were also examined since they are an easy way of identifying the extent of departures from linearity, non-constant variance and the existence of outliers.

4.2.1 Theoretical Basis of the Analysis

To describe the relationship between the response variable and the explanatory variables using multiple regression model we denote the response variable by y and the explanatory variables by $x_1, x_2, ..., x_k$. The true functional relationship between y and $x_1, x_2, .., x_k$ is unknown, but the multiple linear regression model is an adequate approximation (Montgomery and Peck, 1992). This model is given as

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ... + \beta_k x_k + \in ,$$

where $\in$ is the random error term, β_j, $j = 0, 1, ..., k$ are the unknown parameters (called the regression coefficients) that need to be estimated. β_0 is the intercept and each β_j, $j = 1, 2, ..., k$ measures the expected change in y per unit change in x_j when all x_i, $i \neq j$ are kept constant.

The method of least squares is the usual method used to estimate these unknown parameters. In estimating the parameters using the method the following assumptions have to be made.

i) the expectation of the error term (ϵ) is a zero vector, i.e.,

$E(\epsilon) = (0, 0, ..., 0)'$

ii) $\text{var}(\epsilon_i) = \sigma^2 > 0$, $i = 1, 2, ..., n$ (constant variance)

iii) the errors are not correlated

The assumption of normality of the errors is required to make inferences, but not necessary for the least - squares fitting of the regression model.

The distribution of the error term has important implications for the estimation and interpretation of the effects of the variables in the model. The statistical properties of the estimated regression model depend upon the distribution of the error term.

Suppose y_i denote the i^{th} observed response, $i = 1, 2, \ldots, n$ and x_{ij} denote the i^{th} level of the j^{th} explanatory variable. Then the above model can also be written as

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + ... + \beta_k x_{ik} + \epsilon_i, \; i = 1, 2, ..., n$$

Then the least squares estimators of the unknown coefficients can be obtained by minimizing $S(\beta_0,\beta_1,...,\beta_k) = \sum_{i=1}^{n} \epsilon_i^2$ with respect to β_0, β_1, ..., β_k. The estimators are denoted by $\hat{\beta}_0, \hat{\beta}_1, \ldots, \hat{\beta}_k$. Differentiating $S(\beta_0, \beta_1, ..., \beta_k)$ with respect to β_j, $j = 0, 1, 2, ..., k$ gives $k + 1$ equations called normal equations. The solutions of these $k + 1$ equations are the least squares estimators.

4.2.2 Variable Selection and Model Building

This study involves seventeen explanatory variables x_{01}, x_{02}, ..., x_{17} and a response variable. The objective of the study is to determine (select) the most important subset of these seventeen explanatory variables and the corresponding "best-fitting" regression model for describing the relationship between y and the x's.

For the purpose of selecting this best regression equation different types of statistical procedures (the all - possible regression, backward elimination, forward selection and stepwise regression procedures) are usually suggested by different statisticians. Although none of the procedures generally guarantees that the best subset regression model of any size will be identified (Montgomery and Peck, 1992), in this study the stepwise regression procedure was employed to select the "best" least squares fit. That is, the variables under study were subjected to the stepwise regression analysis. Actually since the number of explanatory variables is large it is tedious to use the all-possible regression procedure. However, the variables x_6 (high school Mathematics score) and x_{10} (ESLCE GPA) were not entered into the equation. This is done because the least squares fit (model) can be seriously affected due to the inclusion of the correlated variables (Cook and Weisberg, 1985). Multicollinearity is said to exist in the data when two or more explanatory variables are highly correlated. As it was presented in Table 4.1.19 the variables x_{06} and x_{10} are highly intercorrelated. Moreover, each of these is highly correlated with x_{07} (high school overall average) and also with x_{09} (ESLCE mathematics grade). The statistical literature suggests that a small condition number, say less than 100, indicates multicollinearity is not severe. All the seventeen variables were entered into the regression equation to check if the variables satisfy this condition. But collinearity diagnostics results indicated that there is a moderate multcollinearity since the condition number is equal to 125.444. Discarding

x_{06} and refitting the regression equation for the remaining sixteen variables gave rise to condition number equal to 120.47. Again x_{10} which entered the equation lastly was discarded and the model was refitted for the remaining fifteen variables. Results indicated that there is no severe problem with multicollinearity in using the data set based on these fifteen variables since now the condition number (94.801) is less than 100. Before discarding the two variables scatter plots(see Figure 4.2.9 – 4.2.11) of x_{10} versus x_{07}, x_{06} versus x_{05}, and x_{06} versus x_{10} were examined. The plots showed strong linear dependence between x_{10} and x_{06}, x_{10} and x_{07}, and x_{06} and x_{05}.

The results of the stepwise regression analysis are presented in Table 4.2.1 and Table 4.2.2. Under the assumptions of the model, the test for significance of regression is presented in Table 4.2.1. It is used to test if there is a linear association between the response variable and any of the explanatory variables. From the Table the test statistic F is equal to 49.597. Entering the percentage points of the F-distribution with 6 and 95 degrees of freedom at a 0.01 level of significance we find the critical value to be 3.027. Therefore, as $49.597 > 3.027$ at least one of the explanatory variables x_{01}, x_{02}, x_{03}, x_{07}, x_{09} and x_{12} contributes significantly to the model. That is, there is a linear relationship between the response (y) and at least one of these explanatory variables. Moreover, the tests for the significance of any individual regression coefficients, β_j, are presented in Table 4.2.2. From the percentage points of the t-distribution, $t_{0.025,\ 95} = 1.988$. But from the Table the magnitude of the statistic T for each variable is larger than this critical value. Thus, each of these six variables contributes significantly to the model given that the others are in the model at 0.05 level of significance.

Table 4.2.1 Summary Output

Regression Statistics

Multiple R = 0.871

R square = 0.758

Adjusted R^2 = 0.743

Standard Error = 9.662

ANOVA

Source	df	SS	MS	F
Regression	6	27782.186	4630.364	49.597
Residual	95	8869.174	93.360	
Total	101	36651.36		

Table 4.2.5 Results of Stepwise Regression Analysis

Step	Variable	β	SE β	Beta	T	Sign T	R^2	F
1	x_{07}	1.169	0.098	0.642	11.972	0.0000	0.542	118.19
2	x_{02}	-4.561	0.859	-0.289	-5.311	0.0000	0.634	85.572
3	x_{09}	5.590	1.612	0.188	3.468	0.0008	0.669	66.110
4	x_{03}	10.787	2.291	0.254	4.708	0.0000	0.704	57.592
5	x_{01}	7.809	2.335	0.234	3.344	0.0012	0.733	52.660
6	x_{12}	-6.122	1.946	-0.161	-3.145	0.0022	0.758	49.597
	intercept	42.425	18.129		2.340	0.0214		

4.2.3 Residual Analysis

To use the model for prediction further analyses regarding model adequacy are required. Examination of standard summary statistics such as the t or F statistics or R^2 known as global model properties (Montgomery and Peck, 1992) cannot be used to detect departures from model assumptions. Therefore, it is a usual practice that after fitting the model the next step is to check for model adequacy. Checking model adequacy is equivalent to checking if the model assumptions are valid. That is, checking for the validation of the

assumptions of linearity, homogeneity of variance, normality and independence of errors. This can be carried out through residual analysis.

The normal probability plot of residuals is an excellent way of evaluating the normality assumption. The normal probability plot of standardized residuals is presented in Figure 4.2.1. As it can be seen from the Figure there is no apparent departure from normality assumption as the plot approximate a diagonal straight line. Therefore, it seems reasonable to say the assumption that the errors are normally distributed is valid.

The plot of residuals versus the predicted values of the response variable is presented in Figure 4.2.2. It supports that the assumptions of linearity and constant variance look acceptable since the plots lie within a horizontal band.

To examine the presence of outliers in the data set an outlier test was performed. The test statistic is the externally studentized residual (called deleted studentized residual in SPSS). If errors are normally distributed, then this test statistic will be distributed as student's t-distribution with n - k - 1 degree of freedom, where k is the number of explanatory variables included in the model (Weisberg, 1985). The construction of the test statistic is also given in Weisberg (1985), and it is suggested that testing the case with the largest value of this test statistic (in magnitude) to be an outlier is in reality amounts to performing n significance tests one for each of n cases. The deleted studentized residuals were presented in Appendix II. From the Appendix the largest value (in magnitude) is 2.254 corresponding to case 52. But we have n = 102, and k = 6. Thus, the test statistic has 95 degrees of freedom. As indicated in Weisberg (1985, p.116) choosing the critical value to be the $\left(\frac{\alpha}{n}\right)$ 100% point of t will give a significance level of no more than $n\left(\frac{\alpha}{n}\right) = \alpha$. Using this fact and entering Table E in Weisberg (1985) with k = 6 and n = 102, we find

the critical value at $\alpha = 0.05$ to be 3.60. Then as 2.254 is less than 3.60 case 52 is not an outlier and thus so do the other cases.

The partial regression plots of x_{01}, x_{02}, x_{03}, x_{07}, x_{09} and x_{12} do not show any apparent deviation from the assumption of linearity. These partial regression plots are presented in Figures 4.2.3 - 4.2.8.

Plot of residuals versus ESLCE GPA (categorized) was also examined to check the assumption that the errors are not correlated. From the plot no any apparent trend was observed. Therefore, the assumption that the errors are uncorrelated is not violated. The plot is presented in Figure 4.2.12. The assumption of independence of errors follows from the normality assumption and the assumption that the errors are not correlated.

4.2.4 Influence Diagnostics

The influence of a subset of the data set on the fitted regression model was examined since predictions may depend on the influential subset of data than on the majority of data (Montgomery and Peck, 1992) and this subset may have a serious impact on model properties. As it can be seen from Appendix II the leverage values are all small enough indicating that there is no extremely remote point in the data set. We may also use a rough guideline given in Montgomery and Peck (1992), which says a leverage value larger than 2p/n corresponds to a potentially influential point, where p is the number of regression coefficients in the model. But 2p/n is given to be 0.137 and all leverage values as indicated in Appendix II are smaller than this value. Therefore, no extremely remote point is observed in the data set and thus the parameter estimates, predicted values, and summary statistics are not much affected by the observations in the data set in general.

Cook's distance measure, D_i, was also examined to see the influence of the i^{th} observation on the least squares estimate (the regression coefficient $\hat{\beta}$). As it is described in Montgomery and Peck (1992) D_i is made up of a component that reflects how well the model fits the i^{th} observation y_i and a component that measures how far that point is from the rest of the data. It was suggested that observations with large D_i, preferably $D_i > 1$, may have significant influence on the least squares estimates. However, for each observation in the data set, $D_i < 1$ suggesting that the i^{th} observation alone may not have significant influence on the least squares estimates.

In addition to Cook's distance measure the diagnostics $DFBETAS_{j,i}$ $j = 1, 2, \ldots, k$ were also examined to see the influence of each observation on the regression coefficients. Using the suggestion given by Belsley, Kuh, and Welsch (1980) the absolute value of this statistic has to be compared with $2/\sqrt{n}$, and if it is larger than $2/\sqrt{n}$, then the corresponding observation is the most influential in relation to the others. Since n = 102 we have $2/\sqrt{n} = 0.198$. Comparing this result with $|DFBETAS_{j,i}|$ which was given in Appendix II indicates that the 9^{th}, 54^{th}, 62^{th}, 64^{th}, 69^{th}, 75^{th} and 96^{th} observations have strong influences on the regression coefficients in relation to the others.

The influence of the i^{th} observation on the predicted value was examined through the statistic $DFFITS_i$, i = 1, 2, ..., n. Belsley, Kuh, and Welsch (1980) suggest a convenient size-adjusted cutoff point so as to suspect the i^{th} observation as influential. This cut-off would be $2\sqrt{p/n}$, where p is the number of regression coefficients in the model. Using this cut-off point $\left(2\sqrt{p/n} = 0.524\right)$ and comparing it with the $|DEFITS_i|$ which was given in Appendix II we may conclude that the 9^{th}, 11^{th}, 14^{th}, 16^{th}, 18^{th}, 20^{th}, 54^{th}, 62^{th}, 69^{th}, and 75^{th} observations are the most influential observations in relation to the others.

Another statistic which provides information regarding the overall precision of estimation is the $COVRATIO_i$, i = 1, 2, ..., n. Belsley, Kuh, and Welsch (1980) suggest that if $|COVRATIO_i - 1| > 3p/n$, then the i^{th} observation would be considered as influential. For n = 102, and p = 7, observations with $COVERATIO_i > 1 + 3p/n = 1.206$ or $COVRATIO_i < 1 - 3p/n = 0.794$ should be considered influential. Therefore, the 6^{th}, 17^{th}, 52^{th} and 71^{th} observations are the most influential observations. They influence the overall precision of estimation in relation to others.

For more information on influence diagnostics, see Montgomery and Peck (1992), Belsley, Kuh, and Welsch (1980), Weisberg (1985) and Cook and Weisberg (1982).

4.2.5 Multicollinearity

Collinearity diagnostics were carried out to see if there is multicollinearity problem in the data set or if there is linear dependence among the explanatory variables included in the model. Table 4.2.6 presents the variance inflation factors (VIF) of the variables in the model.

Table 4.2.6 Variance Inflation Factor

Variable	VIF
x_{01}	1.237
x_{02}	1.159
x_{03}	1.142
x_{07}	1.127
x_{09}	1.157
x_{12}	1.033

As it is suggested in Montgomery and Peck (1992) variance inflation factors larger than 10 imply serious problems due to the presence of multicollinearity. However, as it can be

seen in Table 4.2.6 all variance inflation factors are less than 10 suggesting that the problem of multicollinearity is not serious. Another way of checking the existence of severe multicollinearity is to use the condition number as described in section 4.2.2. The condition number for the fitted model is 59.399, which supports the fact that there is no severe multicollinearity.

CHAPTER V

Discussion, Conclusion and Recommendation

In this Chapter some important points of the study are discussed; conclusions and their implications are forwarded by way of summarizing the results.

The variables x_{02}(Age), x_{03}(place high school was attended), x_{05}(high school English average sore), x_{06}(high school mathematics average score), x_{07}(high school overall average score), x_{09}(ESLCE mathematics grade), x_{10}(ESLCE GPA) and x_{13}(economic status of the parents) were found to be significantly correlated with the criterion variable (y) at 0.01 level of significance. Some of the explanatory variables were also significantly intercorrelated at 0.01 level of significance. Note that the variables x_{05}, x_{06}, x_{07} and x_{10} were highly intercorrelated. These high intercorrelations may indicate the existence of multicollinearity. To maximize prediction, however, the problem of multicollinearity (see Section 4.2.2) has been minimized or statistically controlled. The finding that the ESLCE GPA was highly correlated with the criterion variable (y) contradicts the findings of Marhatibeb (1993), who reported that ESLCE variables have weak relations with the scores earned in the college. The types of the subjects considered in the two findings may contribute to these conflicting results. The findings of Marhatibeb (1993) were based on diploma students while the present findings are based on degree students. The batches of the students may also contribute for this.

Results from the stepwise regression analysis(see Table 4.2.2) indicated that the variable x_{07} (high school overall average) alone accounted for about 54% of the variation in y (average score). The variables age, ESLCE Mathematics grade, place high school was attended, sex, and mother's education, however, accounted for 9.5%, 3.5%, 3.5%, 3%, and

2.5% of the variation in the first year first semester average score (y), respectively.

In the present study, although not all potential variables may be considered, it was found out that the high school average score, age upon admission, ESLCE Mathematics grade, place high school was attended, sex and mother's education as predictors of first year first semester average score. The results of stepwise multiple regression analysis indicated that the high school average score is the first best predictor of this average score earned in the College. This finding is consistent with the findings of Wolfe and Johnson (1995), who reported that the average grade earned in the high school is the first best predictor of GPA. It is also in tune with the findings of Laekemariam (1994) and Fantu, et al. (1996), who reported that the high school records of students have significant contribution to the freshman first semester GPA.

Age of student upon admission is the second best predictor of first year first semester average score which is consistent with the findings of High (1996), who investigated age as a good predictor of the performance of the student, and Mathewos (1995), who reported that age significantly affects the achievements of students when subjected to chi-square test.

Contrary to the findings of Harrison (1996) the results of stepwise multiple regression analysis in the present study suggest that the variable sex has a statistically significant effect on the first year first semester average score. The present finding supports the findings of Mathewos (1995), who concluded that sex has a statistically significant effect on the achievements of students when subject to chi-square test and also the largest influence in discriminating between high and low academic achievement groups through discriminant analysis.

As in the study of Mekonnen (1987), the ESLCE mathematics grade does significantly predict first year first semester average score indicating that good performance in ESLCE mathematics grades tend to imply good performance in the first year first semester. That is, it appears to do the explanatory work and to account for statistically significant portion of first year first semester average score variance.

When the variable place high school was attended is examined in the role of a predictor, it accounted for a significant share of the first year first semester average score variance. Analysis of the results in the present study also suggests that the educational level of the mother, no matter how it is defined or measured, together with the above predictors maximizes prediction and it also accounted for a significant portion of the first year first semester average score variance indicating that variation in mothers education may lead to varying performance of the students.

The findings that sex, age, place high school was attended, high school overall average, ESLCE mathematics grade and mother's education are best predictors of first year first semester average score support the potential usefulness of these variables in predicting academic performance.

So the major findings of the study are given below:

- No significant difference in performance was found to be observed among or between the different categories of the variables sex, age, school type, ESLCE English grade, father's education, mother's education, textbook, dormitory facility, fear of academic dismissal and group type taking all the students together.

- Significant difference in performance appears between students coming from

  i) Addis Ababa and outside of Addis Ababa

ii) Parents whose monthly income is greater or equal to 201 Birr and those with less than 201 Birr,

And among

iii) different categories of the variables ESLCE mathematics grade, ESLCE GPA, and variables on high school achievements.

- Significant correlations (at $p < 0.01$) are observed between the criterion variable y and the variables age upon admission(x_{02}), region high school was attended (x_{03}), high school mathematics average score(x_{06}), high school English average score(x_{05}), high school overall average score(x_{07}), ESLCE mathematics grade(x_{09}), ESLCE GPA(x_{10}), and parent's economic status(x_{13}).

- Some explanatory variables were found to be intercorrelated. The highest correlation is observed between high school English and Mathematics average scores ($r = 0.7483$). The second largest correlation was 0.7051, which is a bivariate correlation between high school mathematics average score and ESLCE GPA. The lowest is observed between high school overall average score and age upon admission (0.0021). The high school achievement variables were found to be highly (significantly) intercorrelated and highly correlated with the ESLCE variables.

The above conclusions are reached based on results from the chi-square tests. The conclusions given below are drawn from the results of the stepwise regression analysis.

- x_{07} (high school overall average score), x_{01} (sex), x_{02} (age upon admission), x_{09} (ESLCE mathematics grade), x_{03} (regions high school was attended) and x_{12} (mother's education) do significantly predict first year first semester average score. One important point worth mentioning here is that all the variables entered into the

variables entered into the equation are found to be significant predictors of the first year first semester average score.

- x_{04} (school type), x_{05} (high school English average score), x_{08} (ESLCE English grade), x_{11} (father's education), x_{13} (parent's economic status), x_{15} (dormitory facility), x_{14} (text book), x_{16} (fear of academic performance) and x_{17} (group type) do not predict the first year first semester average score as they are removed from the equation by the stepwise procedure.

These conclusions can be considered as valid since as indicated in the residual analysis the basic assumptions of model hold. As the sample size is adequate and the construction of the categories is based on common grounds, the drawn conclusions are justifiable.

At last, it can be recommended that policy makers should think about an alternative admission criterion of students into institutions of higher learning. As discussed above a large portion of the variation in the first year first semester average score is explained by high school overall average score. Based on this ground the inclusion of the high school overall average score as a second thought in the selection of students for admission into institutes of higher learning may make the admission criterion more sound. However, further research will be required before putting this recommendation into practice and to solve the conflicting findings of the present study with the previous ones.

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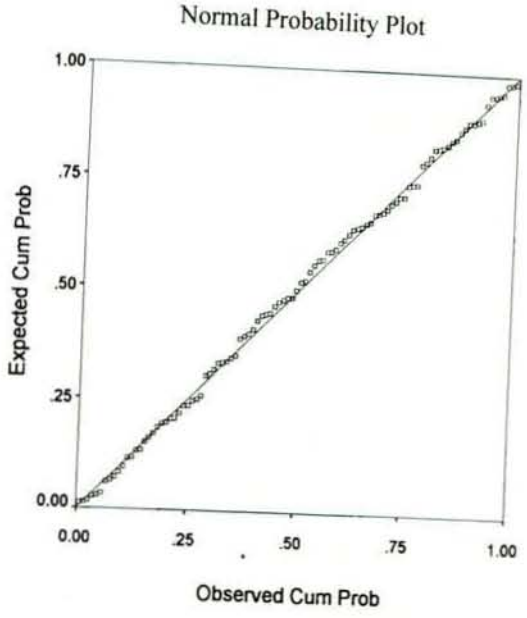


Figure 4.2.1

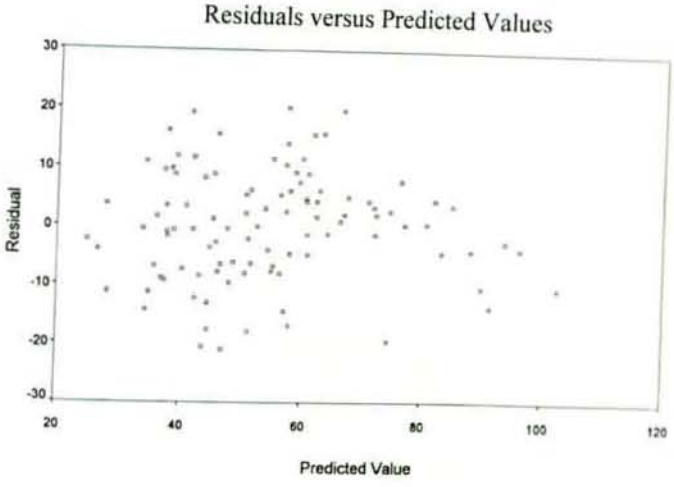


Figure 4.2.2

Partial Regression Plot of X_1

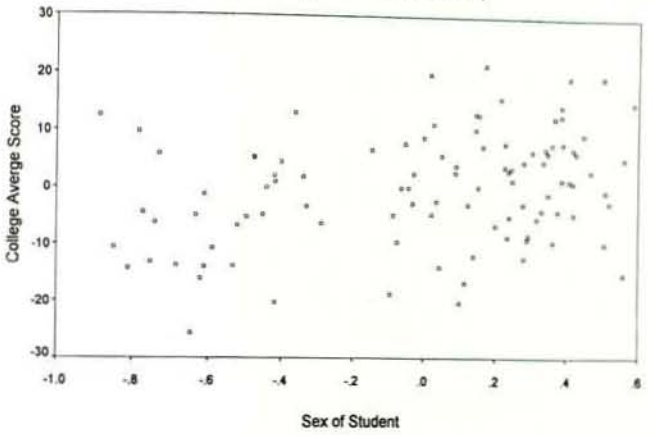


Figure 4.2.3

Partial Regression Plot of X_2

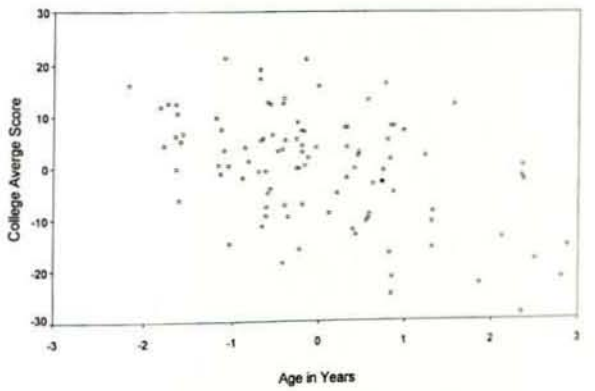


Figure 4.2.4

Partial Regression Plot of X_3

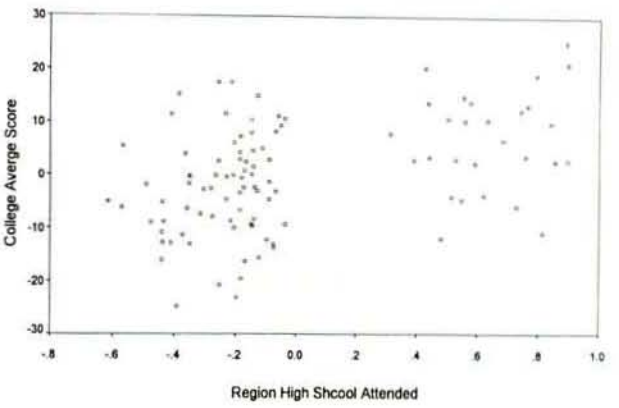


Figure 4.2.5

Partial Regression Plot of X_7

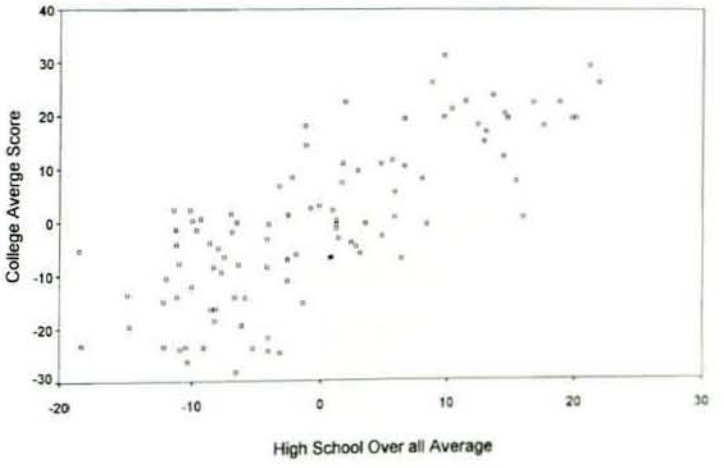


Figure 4.2.6

Partial Regression Plot of X_9

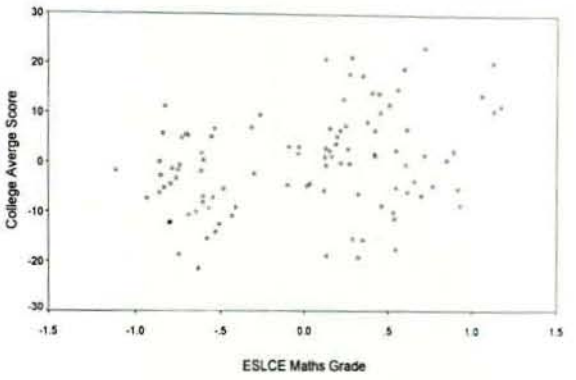


Figure 4.2.7

Partial Regression Plot of X_{12}

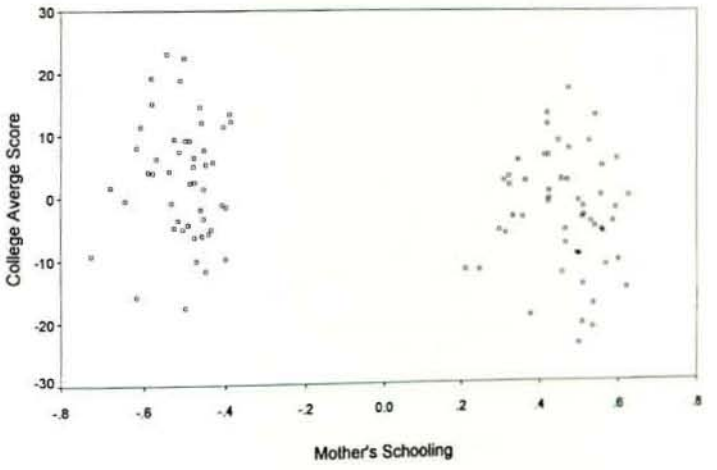


Figure 4.2.8

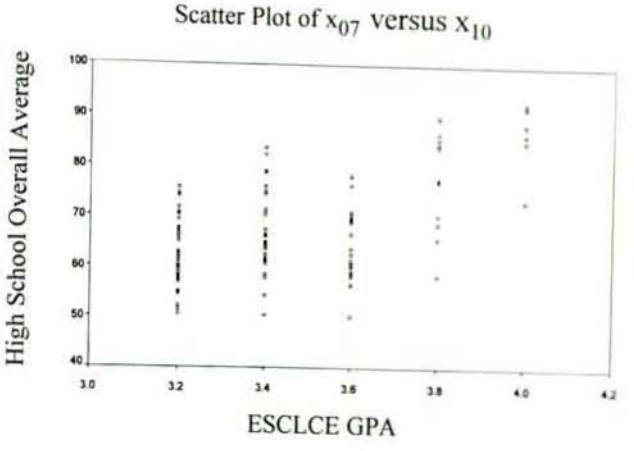
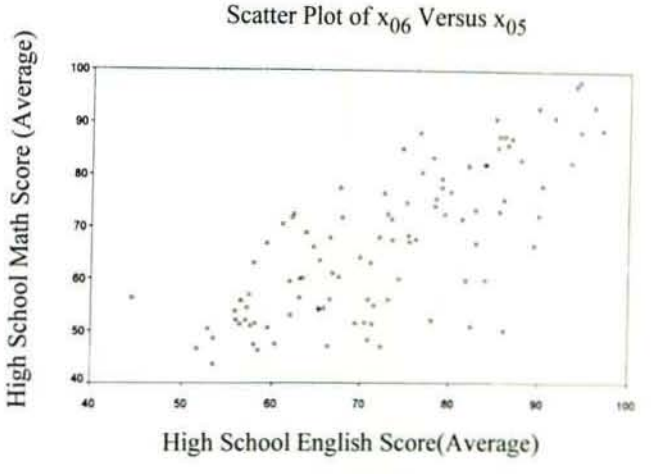


Figure 4.2.9



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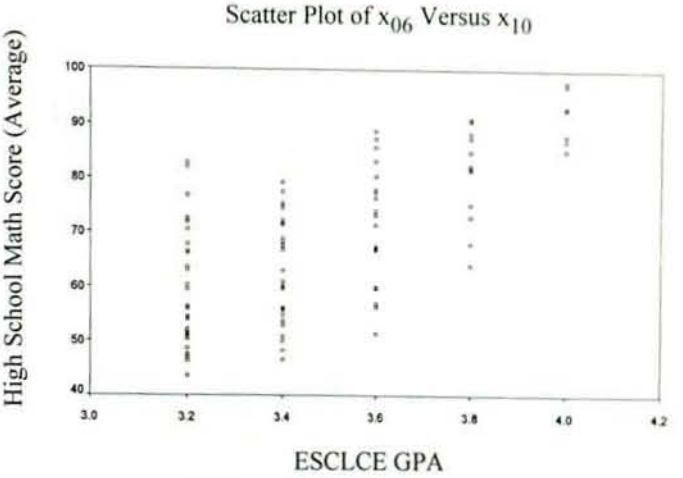

Figure 4.2.11

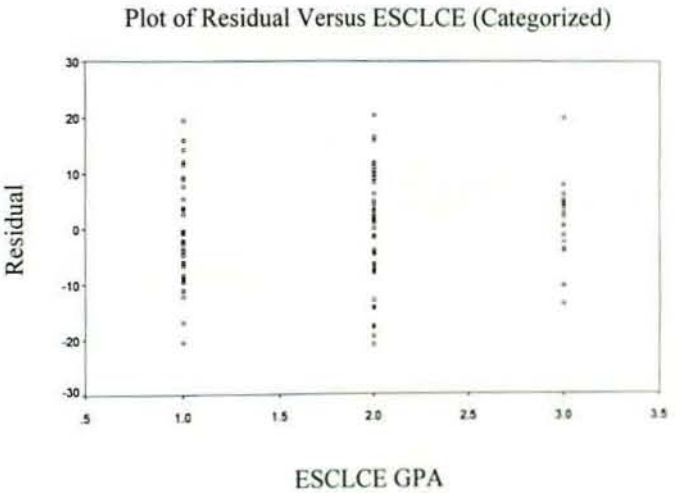

Figure 4.2.12

Appendix I

A Study of Some Selected Factors Affecting Academic Performance of Students at Kotebe College of Teacher Education.

A questionnaire form to be filled by the college students

A. Identification

1. ID. No. _____
2. Section _____
3. Group type: Natural Science ☐
   Social Science ☐
4. Sex _____
5. Age (in complete years) _____
6. Region high school was attended _____
7. High school type
   ☐ Government ☐ Non-government
8. Ethnic group _____

B. Parental educational and economic background

9. Father's education illiterate ☐
   literate ☐
10. Mother's education illiterate ☐
    literate ☐
11. Parents' average monthly income in Birr
    ☐ greater or equal to 201
    ☐ less than 201

C. Physical Environment of the college

12. Have you been provided with at least one textbook or written material (handout) for the course you were registered for?

☐ Yes ☐ No

13. Have you been provided with dormitory with necessary facilities?

☐ Yes ☐ No

14. After you joined the college have you often been frustrated by fear of academic dismissal? Yes ☐ No ☐

Appendix ii

No	pred	res	zres	sres	sdres	cook	lev	cov
1	90.05379	-10.35379	-1.07157	-1.12471	-1.12630	0.01837	0.08246	1.08009
2	51.16864	6.23136	0.64492	0.65610	0.65412	0.00215	0.02401	1.07970
3	37.00231	9.64769	0.99849	1.02454	1.02481	0.00793	0.04040	1.04897
4	47.54597	-0.39597	-0.04098	-0.04181	-0.04159	0.00001	0.02939	1.12067
5	59.61508	11.58492	1.19898	1.25069	1.25446	0.01969	0.07118	1.04321
6	57.08292	20.31708	2.10272	2.13257	2.17399	0.01858	0.01800	0.78574
7	66.35738	19.84262	2.05362	2.09936	2.13847	0.02836	0.03330	0.80703
8	67.38285	5.11715	0.52960	0.55747	0.55544	0.00480	0.08768	1.16614
9	91.50797	-13.65797	-1.41353	-1.50899	-1.51935	0.04542	0.11271	1.03556
10	70.88867	4.41133	0.45655	0.47903	0.47708	0.00331	0.08185	1.16565
11	61.48798	15.71202	1.62612	1.69377	1.71086	0.03481	0.06848	0.94266
12	72.15792	2.14208	0.22170	0.22741	0.22627	0.00039	0.03981	1.12880
13	60.65686	-1.35686	-0.14043	-0.14490	-0.14415	0.00019	0.05092	1.14473
14	102.56098	-10.46098	-1.08266	-1.14796	-1.14990	0.02339	0.10072	1.09792
15	50.42500	2.27500	0.23545	0.24078	0.23958	0.00038	0.03393	1.12134
16	74.34576	-19.54576	-2.02289	-2.10368	-2.14310	0.05151	0.06553	0.83399
17	96.33489	-3.73489	-0.38654	-0.41340	-0.41158	0.00351	0.11589	1.21628
18	57.06665	14.18335	1.46791	1.52793	1.53889	0.02783	0.06722	0.98025
19	60.42314	4.92686	0.50991	0.52606	0.52405	0.00255	0.05068	1.12305
20	37.45348	16.39652	1.69696	1.76286	1.78296	0.03515	0.06356	0.92077
21	38.73986	-0.63986	-0.06622	-0.06927	-0.06891	0.00006	0.07629	1.17792
22	74.53761	2.81239	0.29107	0.30053	0.29909	0.00085	0.05217	1.14042
23	45.16315	1.38685	0.14353	0.14608	0.14533	0.00011	0.02479	1.11373
24	62.62097	6.22903	0.64467	0.65447	0.65249	0.00187	0.01990	1.07530
25	76.99168	0.45832	0.04743	0.04918	0.04892	0.00003	0.05978	1.15722
26	84.93132	3.71868	0.38487	0.39911	0.39734	0.00172	0.06031	1.14456
27	64.03671	-1.23671	-0.12799	-0.13185	-0.13117	0.00015	0.04791	1.14138
28	59.29104	7.65896	0.79267	0.82330	0.82189	0.00763	0.06322	1.10493
29	62.21255	4.33745	0.44891	0.46557	0.46364	0.00234	0.06049	1.13994
30	60.66403	9.08597	0.94035	0.97978	0.97957	0.01174	0.06905	1.08885
31	57.71908	6.13092	0.63452	0.65964	0.65767	0.00502	0.06492	1.12704
32	62.24819	1.65181	0.17095	0.17811	0.17720	0.00039	0.06891	1.16617
33	38.21653	9.88347	1.02289	1.04881	1.04937	0.00807	0.03901	1.04352
34	37.68720	-1.63720	-0.16944	-0.17595	-0.17505	0.00035	0.06281	1.15856
35	80.61435	0.53565	0.05544	0.05787	0.05757	0.00004	0.07267	1.17339
36	76.22551	7.87449	0.81497	0.85605	0.85483	0.01082	0.08386	1.12548
37	60.52061	4.27939	0.44290	0.45221	0.45031	0.00124	0.03096	1.10584
38	93.80644	-2.50644	-0.25940	-0.27455	-0.27321	0.00129	0.09750	1.19964
39	52.33445	0.01555	0.00161	0.00168	0.00168	0.00000	0.07691	1.17913
40	41.81668	11.78332	1.21952	1.24889	1.25263	0.01086	0.03668	1.00581
41	57.84310	-16.99310	-1.75870	-1.81328	-1.83576	0.02961	0.04949	0.89461
42	38.96642	11.98358	1.24024	1.26777	1.27189	0.01031	0.03315	0.99854
43	66.18179	1.01821	0.10538	0.10987	0.10930	0.00015	0.07034	1.16968
44	71.80734	3.39266	0.35112	0.36000	0.35835	0.00095	0.03892	1.12128
45	42.30664	-12.20664	-1.26333	-1.29149	-1.29611	0.01074	0.03333	0.99420
46	44.45886	-17.55886	-1.81726	-1.85051	-1.87485	0.01807	0.02581	0.86360
47	44.38761	-12.98761	-1.34415	-1.37324	-1.37976	0.01178	0.03211	0.97681
48	28.11779	-11.11779	-1.15064	-1.18419	-1.18673	0.01185	0.04606	1.02784
49	36.78542	-8.88542	-0.91960	-0.96773	-0.96740	0.01437	0.08720	1.11267
50	34.78598	-11.23598	-1.16287	-1.20765	-1.21060	0.01635	0.06298	1.04221
51	26.54451	-3.94451	-0.40824	-0.42902	-0.42717	0.00275	0.08475	1.17330
52	46.91293	-20.96293	-2.16956	-2.20718	-2.25409	0.02434	0.02399	0.77102

Appendix ii

No.	pred	res	zres	sres	sdres	cook	lev	cov
53	24.82004	-2.37004	-0.24529	-0.26044	-0.25916	0.00123	0.10316	1.20797
54	43.71298	-20.56298	-2.12817	-2.20451	-2.25121	0.05070	0.05825	0.80010
55	34.28887	-14.23887	-1.47365	-1.52380	-1.53463	0.02296	0.05493	0.96829
56	51.35988	-6.30988	-0.65304	-0.66740	-0.66544	0.00283	0.03277	1.08837
57	71.98322	-1.28322	-0.13281	-0.13728	-0.13657	0.00018	0.05428	1.14902
58	60.82558	-4.82558	-0.49942	-0.50923	-0.50724	0.00147	0.02834	1.09837
59	88.14841	-4.04841	-0.41899	-0.44263	-0.44075	0.00325	0.09415	1.18458
60	50.37090	-7.97090	-0.82495	-0.85328	-0.85205	0.00727	0.05550	1.09172
61	40.20404	-7.30404	-0.75593	-0.78308	-0.78147	0.00640	0.05832	1.10439
62	51.01619	-17.96619	-1.85941	-1.97534	-2.00656	0.07167	0.10413	0.90615
63	46.50050	-6.45050	-0.66760	-0.69811	-0.69622	0.00651	0.07571	1.13594
64	56.90421	10.54579	1.09144	1.13682	1.13860	0.01567	0.06845	1.06149
65	46.00057	-7.70057	-0.79697	-0.81563	-0.81418	0.00450	0.03543	1.07377
66	37.28566	-9.23566	-0.95585	-0.99576	-0.99571	0.01208	0.06875	1.08594
67	43.65398	8.29602	0.85860	0.90376	0.90288	0.01260	0.08763	1.12316
68	57.26478	2.63522	0.27273	0.27889	0.27753	0.00051	0.03386	1.11961
69	63.12122	15.92878	1.64855	1.71741	1.73550	0.03593	0.06877	0.93720
70	54.16857	-4.01857	-0.41590	-0.43246	-0.43060	0.00217	0.06531	1.14839
71	81.93889	4.61111	0.47723	0.51315	0.51115	0.00588	0.12529	1.22114
72	56.19364	-8.04364	-0.83248	-0.84508	-0.84380	0.00311	0.01979	1.05264
73	45.21905	8.98095	0.92949	0.96621	0.96586	0.01075	0.06476	1.08593
74	50.49717	5.40283	0.55917	0.57929	0.57726	0.00351	0.05848	1.12753
75	41.36952	19.43048	2.01096	2.09816	2.13719	0.05572	0.07158	0.84100
76	35.59999	-6.74999	-0.69859	-0.71752	-0.71568	0.00404	0.04227	1.09364
77	58.54712	9.30288	0.96280	0.98789	0.98776	0.00736	0.04034	1.05468
78	41.91358	-0.51358	-0.05315	-0.05502	-0.05473	0.00003	0.05700	1.15372
79	48.52366	-6.07366	-0.62859	-0.65116	-0.64917	0.00443	0.05829	1.11996
80	53.64524	3.10476	0.32133	0.33094	0.32938	0.00095	0.04744	1.13310
81	83.22715	-4.42715	-0.45819	-0.47636	-0.47442	0.00262	0.06504	1.14468
82	45.70276	-2.65276	-0.27455	-0.28642	-0.28503	0.00104	0.07138	1.16497
83	27.77033	3.82967	0.39635	0.41053	0.40873	0.00175	0.05808	1.14104
84	35.94744	1.70256	0.17621	0.18035	0.17943	0.00022	0.03567	1.12549
85	38.67459	8.92541	0.92374	0.96313	0.96275	0.01154	0.07032	1.09297
86	54.76912	11.58088	1.19857	1.24014	1.24371	0.01551	0.05613	1.02842
87	44.64385	-3.59385	-0.37195	-0.37982	-0.37810	0.00088	0.03121	1.11106
88	50.91184	-2.11184	-0.21856	-0.22575	-0.22462	0.00049	0.05288	1.14459
89	57.03106	-14.48106	-1.49872	-1.53234	-1.54344	0.01522	0.03359	0.94483
90	57.84283	-4.69283	-0.48569	-0.50411	-0.50212	0.00281	0.06194	1.13857
91	34.00017	11.04983	1.14360	1.19253	1.19522	0.01776	0.07057	1.05367
92	56.14491	5.40509	0.55940	0.56946	0.56742	0.00168	0.02520	1.08956
93	66.73048	2.11952	0.21936	0.22640	0.22527	0.00048	0.05146	1.14284
94	37.56409	-0.86409	-0.08943	-0.09154	-0.09106	0.00006	0.03575	1.12759
95	55.07067	-6.77067	-0.70073	-0.75070	-0.74897	0.01189	0.11890	1.18554
96	45.69648	15.80352	1.63559	1.69120	1.70818	0.02826	0.05488	0.92956
97	54.81384	-7.66384	-0.79317	-0.81693	-0.81549	0.00580	0.04751	1.08736
98	33.73111	-0.38111	-0.03944	-0.04088	-0.04067	0.00002	0.05943	1.15685
99	47.92311	-9.62311	-0.99595	-1.03948	-1.03992	0.01379	0.07220	1.08281
100	43.02809	-8.37809	-0.86709	-0.89483	-0.89388	0.00744	0.05123	1.08091
101	40.65153	3.49847	0.36208	0.37976	0.37805	0.00206	0.08118	1.17214
102	37.40252	3.54748	0.36715	0.38243	0.38070	0.00178	0.06850	1.15585

Appendix ii

No	dff	dfbInt	dfbX01	dfbX03	dfbX07	dfbX09	dfbX12	dfbX02
1	-1.05244	2.29477	-0.15623	-0.39806	-0.00976	-0.29069	-0.11433	-0.03607
2	0.21807	0.38513	0.08591	-0.04085	-0.00458	0.06849	-0.12778	-0.00953
3	0.50997	1.74825	0.21774	-0.08480	-0.00727	-0.19898	0.24625	-0.04627
4	-0.01615	-0.03096	-0.00597	0.00208	0.00042	-0.00484	0.00797	0.00058
5	1.02081	-1.56138	0.28343	0.63577	-0.01208	0.15775	-0.29678	0.09723
6	0.58098	-0.00668	0.20869	-0.30221	0.00391	0.07810	0.40086	-0.02809
7	0.89376	-3.71000	0.01976	-0.25014	0.02055	0.16592	-0.45697	0.12468
8	0.55270	-0.59409	0.11937	0.24387	-0.00637	0.18438	0.07380	0.02058
9	-1.90692	-2.73314	-0.45947	-0.63778	0.00228	-0.40300	0.45921	0.19816
10	0.44511	-0.58126	0.09672	0.20279	-0.00397	0.15264	0.06097	0.01728
11	1.33453	0.71960	0.49973	0.85331	-0.01992	0.16771	-0.40179	-0.00221
12	0.11183	-0.14521	0.01148	-0.04475	0.00339	-0.00212	0.03875	-0.00373
13	-0.08772	-0.40513	-0.03267	0.01518	-0.00086	0.03464	0.02663	0.01893
14	-1.29986	0.94476	-0.20085	-0.36124	-0.01851	-0.22945	-0.10106	0.05762
15	0.10405	0.48064	0.04660	-0.02804	-0.00183	0.00882	0.04825	-0.02144
16	-1.59246	-3.41546	-0.68874	-0.96707	0.00888	-0.07936	0.52946	0.17330
17	-0.53693	-0.40072	-0.03073	0.11469	-0.00861	-0.07231	-0.05139	0.06039
18	1.18356	1.33306	0.19205	-0.20111	-0.01597	0.47952	0.26115	-0.08486
19	0.31720	1.47590	0.11899	-0.05468	0.00302	-0.12535	-0.09651	-0.06868
20	1.29819	4.55094	0.42106	-0.12638	-0.03364	0.13683	0.38916	-0.15471
21	-0.06028	-0.05701	0.01353	-0.02695	0.00087	0.00584	0.01383	-0.00176
22	0.18581	-0.64071	-0.00510	-0.04494	0.00511	0.01638	-0.06931	0.01752
23	0.04970	0.07236	0.01990	-0.01465	-0.00123	0.01068	0.02982	-0.00158
24	0.19069	0.07072	0.06166	-0.06697	0.00186	0.04536	-0.13689	-0.01100
25	0.03428	-0.11041	-0.00123	-0.00782	0.00095	0.00232	-0.01155	0.00285
26	0.28038	-0.36936	0.08115	0.14260	0.00503	-0.00993	0.05243	-0.00143
27	-0.07574	-0.03408	0.03471	-0.03254	-0.00016	-0.00818	-0.01901	0.00253
28	0.60334	0.66954	-0.19408	0.26853	-0.00556	0.10534	-0.20377	-0.01726
29	0.32795	0.32010	-0.11401	0.14675	-0.00195	0.05525	-0.11686	-0.01003
30	0.77783	-0.46051	-0.27478	0.24295	0.01037	-0.19911	0.16888	0.02286
31	0.49509	2.51749	0.17277	-0.05361	-0.00587	0.02914	-0.13409	-0.11410
32	0.14113	0.01290	-0.08106	-0.06213	0.00238	0.00782	0.03069	-0.00620
33	0.50726	2.09720	0.23335	-0.02881	-0.01029	-0.15502	-0.16306	-0.05025
34	-0.12818	-0.45229	-0.04187	0.01276	0.00332	-0.01352	-0.03877	0.01544
35	0.04815	-0.13984	-0.00214	-0.01002	0.00131	0.00209	-0.01396	0.00334
36	0.81377	-2.97836	-0.07470	-0.17838	0.01201	0.25586	0.12185	0.08419
37	0.18184	0.86542	0.07908	-0.04188	-0.00119	0.02509	-0.09291	-0.04227
38	-0.30127	0.09714	-0.00559	0.05679	-0.00502	-0.06978	0.07758	0.01835
39	0.00148	0.00232	-0.00063	-0.00055	0.00002	-0.00038	0.00035	-0.00012
40	0.57447	-0.92135	0.11019	-0.04053	-0.01424	0.19298	-0.23230	0.08056
41	-1.07107	-0.94489	0.44142	-0.48787	0.00758	-0.14725	-0.27645	0.03258
42	0.53790	-1.21861	0.10550	-0.10356	-0.01278	0.14341	0.26738	0.08556
43	0.08872	0.12098	0.03623	0.05236	0.00010	-0.02344	-0.02411	-0.00426
44	0.17376	-0.22445	0.01857	-0.07037	0.00525	-0.00297	0.06148	-0.00588
45	-0.55032	-2.35291	-0.26956	0.05404	0.00807	0.20651	0.20708	0.06276
46	-0.64851	2.19722	-0.12096	0.18638	0.00985	-0.17750	-0.37559	-0.12236
47	-0.56813	1.15887	-0.10956	0.05694	0.01257	-0.20087	0.25942	-0.08765
48	-0.65784	-0.42218	-0.19876	0.06433	0.01316	0.17355	-0.29669	-0.04042
49	-0.95448	3.94818	0.04261	0.02033	0.00830	-0.21024	0.18276	-0.21874
50	-0.88196	-1.50232	0.43985	0.30083	0.01300	-0.15614	-0.25137	0.03501
51	-0.41190	1.05065	0.21604	0.07763	0.00087	0.01213	0.07055	-0.07324
52	-0.73324	2.84466	-0.12686	0.24115	0.00709	-0.19499	-0.44053	-0.14470

Appendix ii

No.	dff	dfbInt	dfbX01	dfbX03	dfbX07	dfbX09	dfbX12	dfbX02
53	-0.30182	1.02933	0.00498	0.01014	0.00403	-0.05352	-0.06087	-0.06074
54	-1.50163	-2.66761	0.83356	0.48563	0.01487	-0.33456	0.44592	0.07346
55	-0.98552	3.82850	-0.03812	0.10490	0.01606	-0.22835	-0.33114	-0.22431
56	-0.28055	-1.30528	-0.12708	0.07987	0.00453	-0.02253	-0.13285	0.05951
57	-0.08786	0.01072	0.03980	-0.03009	-0.00112	-0.00516	-0.01842	0.00287
58	-0.19135	-0.79170	-0.08133	0.07780	-0.00070	-0.00241	-0.09486	0.04628
59	-0.46967	0.99155	0.02272	0.11071	-0.00926	-0.10688	-0.05725	-0.00741
60	-0.55688	0.69461	0.40403	0.21051	-0.00240	-0.12955	0.18172	-0.03699
61	-0.53394	0.29956	0.34549	0.16497	0.00475	-0.14379	0.15650	-0.03564
62	-2.31012	8.30520	0.11011	0.28882	-0.03307	0.35795	-0.44066	-0.37648
63	-0.60318	0.11243	-0.21342	-0.33888	0.00615	0.12711	-0.14370	-0.03255
64	0.89529	1.30269	0.39267	0.51042	-0.00387	-0.26708	0.21989	-0.03895
65	-0.36484	-1.07954	-0.14934	0.09331	-0.00057	0.18051	-0.18595	0.03823
66	-0.78735	-1.48572	0.35775	0.19754	0.01238	-0.17196	0.19406	0.03204
67	0.89558	-3.47713	-0.02795	-0.10671	0.00908	-0.14127	0.20869	0.17206
68	0.12030	0.33296	0.04485	-0.02642	0.00186	-0.05739	-0.05017	-0.01441
69	1.35840	2.02094	-0.36676	0.41566	0.01542	-0.39835	0.29418	-0.09573
70	-0.32636	-0.82493	0.07341	-0.14451	0.00117	0.06612	0.09375	0.02437
71	0.72025	1.12451	-0.10600	0.09385	0.01152	-0.16515	0.07865	-0.07320
72	-0.24532	-0.31786	-0.09690	0.06740	0.00224	-0.07510	0.16972	0.01311
73	0.72361	-0.66040	-0.26958	0.30309	-0.01114	0.13745	0.16255	0.06075
74	0.39595	-0.02003	-0.14241	0.16392	0.00095	-0.09876	0.10707	0.01465
75	1.72154	-4.59454	-1.09772	-0.46021	-0.00275	0.42471	-0.43024	0.26073
76	-0.37077	-1.26803	-0.15588	0.05588	0.00597	0.13639	-0.17394	0.03223
77	0.49112	-0.57451	0.08247	-0.10129	0.01136	-0.18738	-0.18213	0.02496
78	-0.03677	-0.17901	-0.01501	0.00540	0.00036	0.01277	-0.01311	0.00686
79	-0.44383	-1.22193	0.22424	0.16167	-0.00389	0.10354	0.12015	0.04597
80	0.18854	1.02180	0.08197	-0.02635	-0.00006	-0.07180	-0.05766	-0.04267
81	-0.35816	-0.59247	-0.14213	-0.20372	-0.00170	-0.00478	0.12547	0.04011
82	-0.23438	0.45359	0.08789	-0.08572	-0.00034	0.03883	-0.05450	-0.03011
83	0.27889	0.86842	0.10038	-0.02073	-0.00625	-0.06872	0.10461	-0.01793
84	0.08111	0.00456	0.02558	-0.01474	-0.00077	-0.03062	0.04310	0.00583
85	0.77738	-3.12657	-0.00009	-0.03703	0.00167	-0.08516	-0.15925	0.18015
86	0.81741	0.48353	-0.53042	-0.39646	0.00833	0.08288	0.22448	-0.04093
87	-0.15371	-0.65396	-0.07635	0.01901	0.00161	0.06338	0.06199	0.01862
88	-0.14122	-0.64663	-0.05489	0.02936	-0.00028	0.05858	-0.05098	0.02849
89	-0.65690	-1.84422	-0.24754	0.14390	-0.00989	0.31421	0.27515	0.07908
90	-0.36272	1.16128	-0.00612	0.05249	-0.00744	0.08503	0.09466	-0.05241
91	0.96571	-3.63298	0.01811	-0.02576	-0.00283	-0.08803	-0.18979	0.22424
92	0.19606	-0.95427	0.01597	-0.08076	0.00269	0.03429	0.10690	0.03629
93	0.13833	0.18194	0.02981	-0.02930	0.00339	-0.05366	-0.04393	-0.01225
94	-0.04124	0.08271	-0.00804	0.00703	0.00103	-0.01076	-0.01950	-0.00621
95	-1.00013	2.84082	-0.10889	-0.39165	-0.00190	0.08893	0.16298	-0.15378
96	1.09285	-1.04039	-0.77489	-0.38883	-0.00213	0.28118	-0.34961	0.07491
97	-0.46598	-2.48200	-0.19927	0.06844	-0.00069	0.18018	0.14360	0.10554
98	-0.02835	0.01866	0.01777	0.01013	0.00032	-0.00627	-0.00846	-0.00202
99	-0.85961	1.74588	0.32667	-0.30291	-0.00328	0.14821	-0.19480	-0.10885
100	-0.54463	-0.32847	0.35746	0.20640	-0.00438	0.10785	0.15998	-0.00771
101	0.35017	1.38595	-0.09940	-0.10663	-0.00032	-0.07923	0.08698	-0.05557
102	0.30140	0.56861	-0.13752	-0.07602	-0.00471	0.06589	-0.07458	-0.01231

Appendix iii

No.	y	X01	X02	X03	X04	X05	X06	X07	X08	X09	X10	X11	X12	X13	X14	X15	X16	X17
1	79.7	1	19	1	1	76.5	88.0	85.1	4	4	4.0	1	1	1	0	0	0	1
2	57.4	1	19	0	1	73.4	71.5	60.6	4	3	3.6	1	0	1	1	1	1	1
3	46.7	1	19	0	1	63.4	60.1	58.5	4	2	3.4	0	1	0	0	0	1	1
4	47.2	1	19	0	1	83.8	82.0	57.5	3	3	3.2	1	0	0	0	0	1	1
5	71.2	1	20	1	1	85.4	87.4	62.5	4	3	3.6	0	0	0	0	1	0	1
6	77.4	1	19	0	1	78.0	83.3	70.9	3	3	3.6	1	1	1	0	0	0	1
7	86.2	1	20	0	1	93.5	82.5	77.5	4	3	3.8	0	0	1	0	1	0	1
8	72.5	1	19	1	1	69.9	64.1	65.7	3	4	3.8	1	1	1	0	0	0	1
9	77.9	1	17	1	1	85.3	85.3	73.3	4	4	4.0	1	0	1	1	1	0	1
10	75.3	1	19	1	1	74.5	85.0	68.7	3	4	3.8	0	1	1	1	0	1	1
11	77.2	1	19	1	1	76.8	80.5	60.2	3	3	3.6	1	0	1	0	1	1	1
12	74.3	1	19	0	1	85.0	90.8	83.8	4	3	3.8	0	1	1	0	0	1	1
13	59.3	1	18	0	1	97.0	88.8	69.6	4	2	3.6	1	0	1	0	1	0	1
14	92.1	1	18	1	1	94.0	97.3	91.9	4	4	4.0	0	1	1	1	0	0	1
15	52.7	1	18	0	1	73.5	67.5	61.3	4	3	3.6	1	1	1	0	0	0	1
16	54.8	1	18	1	1	66.5	56.0	67.3	4	3	3.4	0	0	1	0	1	0	1
17	92.6	1	17	0	1	94.3	98.0	91.9	4	4	4.0	1	1	1	1	1	0	1
18	71.3	1	18	0	1	87.9	82.9	62.2	4	4	3.2	1	1	1	1	0	0	1
19	65.4	1	18	0	1	86.4	85.8	69.4	4	2	3.6	0	0	1	1	1	0	1
20	53.9	1	18	0	1	72.5	76.5	50.2	4	3	3.6	0	1	1	0	0	0	1
21	38.1	0	19	1	0	64.6	66.1	52.2	4	2	3.2	1	0	1	1	1	1	1
22	77.4	1	20	0	1	85.5	73.0	84.5	4	3	3.8	0	0	0	1	1	0	1
23	46.6	1	19	0	1	63.7	68.9	60.7	3	3	3.4	1	1	0	0	0	1	1
24	68.9	1	19	0	1	59.3	66.8	70.4	3	3	3.6	0	0	1	0	1	1	1
25	77.5	1	20	0	1	94.5	88.5	86.6	4	3	3.8	0	0	1	0	0	1	1
26	88.7	1	19	1	1	86.0	87.5	85.5	4	3	3.8	1	1	1	0	1	0	1
27	62.8	0	18	1	1	82.0	81.8	70.4	4	3	3.8	1	1	1	0	0	0	1
28	67.0	0	18	1	1	66.5	67.8	61.1	4	3	3.2	0	0	1	1	1	1	1
29	66.6	0	18	1	1	67.6	77.5	63.6	3	3	3.6	1	0	1	0	0	0	1
30	69.8	0	19	1	1	84.0	59.8	76.2	4	2	3.6	1	1	1	0	0	0	1
31	63.9	1	17	0	1	84.0	82.0	58.4	3	3	3.8	0	0	1	1	1	1	1
32	63.9	0	18	0	1	82.8	73.3	78.1	4	3	3.6	1	1	1	0	0	1	1
33	48.1	1	19	0	1	76.1	67.6	54.3	4	2	3.4	0	0	0	0	1	0	1
34	36.1	1	18	0	1	75.3	68.3	50.4	4	3	3.4	1	1	1	1	0	0	1
35	81.2	1	20	0	1	91.6	91.1	89.7	4	3	3.8	0	0	1	0	1	0	1
36	84.1	1	20	0	0	86.8	87.1	86.4	4	4	4.0	0	1	1	1	0	1	1
37	64.8	1	18	0	1	67.8	71.8	64.7	3	3	3.4	1	0	0	0	1	0	1
38	91.3	1	18	0	1	89.8	93.0	88.4	4	4	4.0	1	0	1	0	0	1	1
39	52.4	0	18	0	0	82.9	66.9	74.4	4	2	3.4	0	1	1	1	0	0	1
40	53.6	1	20	0	0	78.3	74.1	56.5	4	3	3.6	0	0	0	1	1	1	1
41	40.9	0	18	1	1	89.5	66.5	65.1	4	3	3.2	1	1	1	1	0	0	1
42	51.0	1	20	0	1	62.1	71.8	59.3	2	3	3.2	0	1	0	1	0	1	1
43	67.2	1	19	1	1	90.3	78.0	69.0	4	2	3.6	1	0	1	1	1	1	1
44	75.2	1	19	0	1	78.4	75.4	83.5	4	3	3.4	0	1	1	0	1	0	1
45	30.1	1	19	0	0	58.4	46.3	57.8	3	2	3.2	1	0	0	1	0	1	1
46	26.9	1	20	0	1	62.0	53.0	64.0	4	3	3.4	0	1	0	0	1	1	1
47	31.4	1	20	0	1	74.3	60.0	58.7	3	3	3.6	1	0	1	0	0	0	1
48	17.0	1	20	0	1	56.3	51.3	54.8	4	2	3.2	0	1	1	1	1	0	1
49	27.9	1	22	0	1	57.1	54.4	60.0	3	3	3.2	1	0	0	1	1	0	1
50	23.6	0	18	0	1	53.4	43.6	54.6	4	3	3.2	0	1	1	0	0	1	1
51	22.6	0	21	0	0	44.4	56.4	58.8	4	2	3.6	1	0	1	0	0	1	1
52	26.0	1	20	0	1	63.0	60.0	66.1	3	3	3.4	1	1	0	0	0	1	1
53	22.5	1	22	0	1	55.9	52.1	55.0	4	3	3.2	0	1	0	1	1	1	1

Appendix iii

No.	y	X01	X02	X03	X04	X05	X06	X07	X08	X09	X10	X11	X12	X13	X14	X15	X16	X17
54	23.2	0	18	0	1	57.5	51.0	57.0	3	3	3.2	1	0	1	0	0	1	1
55	20.1	1	21	0	1	57.3	57.0	59.2	3	3	3.6	1	1	0	1	1	1	1
56	45.1	1	18	0	1	52.8	50.4	62.1	3	3	3.2	0	1	1	0	0	1	1
57	70.7	0	18	1	0	86.0	75.3	77.2	4	3	3.8	1	1	1	1	1	0	1
58	56.0	1	18	0	1	80.0	76.8	70.2	3	3	3.2	0	1	0	1	1	0	1
59	84.1	1	19	0	1	96.0	93.3	92.7	4	4	4.0	1	1	1	0	0	0	1
60	42.4	0	19	0	1	75.4	67.1	66.6	4	3	3.6	1	0	1	1	0	1	1
61	32.9	0	19	0	1	55.8	53.8	57.9	3	3	3.4	0	0	0	1	1	0	1
62	33.1	1	22	0	1	90.0	72.3	82.2	3	2	3.4	0	1	1	0	0	0	0
63	40.1	1	20	1	1	82.4	50.9	61.3	4	2	3.4	1	1	0	1	1	0	0
64	67.5	1	19	1	1	66.8	61.0	66.3	4	2	3.4	0	1	0	0	0	0	0
65	38.3	1	19	0	1	71.5	54.9	66.2	4	2	3.4	1	1	1	1	1	1	0
66	28.1	0	18	0	1	56.9	52.0	51.5	2	3	3.2	1	0	1	0	0	1	0
67	52.0	1	22	0	1	81.8	59.8	75.9	4	2	3.4	0	1	0	1	1	1	0
68	59.9	1	19	0	1	61.9	59.5	70.6	3	2	3.2	1	0	0	0	0	1	0
69	79.1	0	18	1	0	63.0	56.3	74.4	4	2	3.2	0	1	1	0	1	0	0
70	50.2	0	18	1	1	66.3	47.0	61.5	4	2	3.2	1	0	1	0	0	1	0
71	86.6	0	17	1	0	72.0	68.0	86.6	4	2	3.8	1	1	1	1	0	1	0
72	48.2	1	19	0	1	56.4	55.8	64.9	3	3	3.4	0	0	1	0	1	0	0
73	54.2	0	19	1	0	58.0	51.4	58.2	4	3	3.6	1	1	1	0	0	0	0
74	55.9	0	19	1	0	67.5	60.3	67.5	4	2	3.2	0	1	1	0	1	1	0
75	60.8	0	20	0	1	65.3	54.0	62.8	3	3	3.2	1	0	1	1	0	1	0
76	28.9	1	19	0	1	53.4	48.6	57.3	4	2	3.2	0	1	0	1	0	1	0
77	67.9	1	20	0	1	62.3	72.5	75.6	3	2	3.2	0	0	1	1	1	0	0
78	41.4	1	18	0	1	65.3	63.6	58.8	4	2	3.2	1	1	0	0	0	0	0
79	42.5	0	18	0	1	73.0	72.5	65.9	4	2	3.2	0	0	1	1	1	0	0
80	56.8	1	18	0	1	79.0	79.3	63.6	4	2	3.4	1	0	1	1	0	1	0
81	78.8	1	18	1	0	75.0	74.6	74.9	3	3	3.4	1	0	1	0	1	0	0
82	43.1	0	20	1	1	60.3	47.5	67.3	4	2	3.2	0	1	1	1	1	1	0
83	31.6	1	19	0	1	73.1	56.0	50.6	3	2	3.2	1	1	1	0	0	0	0
84	37.7	1	20	0	1	51.6	46.6	61.5	4	2	3.4	0	1	1	0	0	0	0
85	47.6	1	22	0	1	71.1	63.0	66.4	4	2	3.2	1	0	0	0	1	0	0
86	66.4	0	18	0	0	61.0	70.5	71.7	4	3	3.2	1	1	1	0	0	1	0
87	41.1	1	19	0	1	59.4	50.6	59.8	3	2	3.2	0	0	1	0	1	0	0
88	48.8	1	18	0	1	70.5	51.5	66.5	4	2	3.2	1	1	1	0	0	1	0
89	42.6	1	19	0	1	57.8	63.0	70.4	3	2	3.4	0	0	0	0	1	1	0
90	53.2	1	21	0	0	81.3	71.5	78.9	4	2	3.4	1	0	1	0	0	0	0
91	45.1	1	22	0	1	70.8	48.3	62.4	4	2	3.4	0	0	0	0	1	0	0
92	61.6	1	20	0	1	79.4	72.4	74.0	3	3	3.2	1	1	1	1	1	0	0
93	68.9	1	19	0	1	79.0	77.6	78.7	4	2	3.4	1	0	1	0	0	1	0
94	36.7	1	20	0	1	69.4	51.4	58.1	3	3	3.2	0	1	0	0	0	1	0
95	48.3	1	22	1	1	70.8	56.1	71.2	4	2	3.4	1	0	1	0	1	0	0
96	61.5	0	19	0	1	71.3	51.3	62.6	4	3	3.2	0	0	0	0	1	0	0
97	47.2	1	18	0	1	86.1	50.1	64.6	4	2	3.4	1	0	1	1	1	0	0
98	33.4	0	19	0	1	57.9	47.4	57.6	3	3	3.2	0	1	1	0	0	0	0
99	38.3	0	20	1	0	78.0	52.0	69.2	4	2	3.2	1	1	1	1	1	1	0
100	34.7	0	19	0	1	72.3	46.9	65.1	4	2	3.2	1	0	0	1	0	1	0
101	44.2	0	17	0	1	65.8	54.3	60.5	4	2	3.2	0	1	0	0	1	0	0
102	41.0	0	18	0	1	65.2	54.3	51.6	4	3	3.2	1	0	0	1	0	1	0

DECLARATION

I, the undersigned, declare that the thesis is my original work, has not been presented for a degree in any other university and all sources of material used for the thesis have been duly acknowledged.

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