A DISCRIMINANT MODEL TO DISTINGUISH BETWEEN SUCCESSFUL ACCOUNTING AND NON-ACCOUNTING STUDENTS IN THE FACULTY OF COMMERCE OF THE UNIVERSITY OF NAIROBI

BY

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This Research Project is my original work and has not been presented for a degree in any other University.

7.7.89

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This Research Project has been submitted for examination with my approval as University Supervisor.

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To my parents, Christina Chepkoech and Benjamin Chirchir

and

To my uncle, Cosma Kandie

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ABSTRACT

Students in the Faculty of Commerce of the University of Nairobi have often found difficulty in choosing which options to pursue upon entering their second year of study. Whereas the Accounting Department has over the years required a student to have done well in first year in Fundamentals of Accounting and Quantitative Methods in order to register for the Accounting option, no other department offers such a guideline to students wishing to do options offered in those departments.

The primary objective of this study was thus to identify the variables that distinguish between students who will perform well in the Accounting option as opposed to those who will perform well in the non-accounting options, which comprise the Marketing option and the Insurance option. To facilitate the study, a sample of sixty students who had passed with at least an Upper Second Class Honours degree in each of the two categories was used to develop a discriminant model. This sample was drawn between the academic years 1979/80 and 1983/84 inclusive.

Another sample of size sixty in each group was drawn from the academic years 1984/85 to 1987/88 and used to validate the discriminant model developed. A successful prediction rate of 80.8% was achieved using the model developed.

Of all the variables used in the study, it was found

that four courses taught in first year, namely Fundamentals of Accounting, Business Law, Quantitative Methods I and Introduction to Economics are the optimal discriminating factors between the two groups, Accounting and non-accounting. Thus, these four courses can form a basis upon which students can be assisted in the choice of an option on entering second year.

It was found that a student who does well in Introduction to Economics is more likely to be classified in a non-accounting option than in Accounting, holding all other factors constant. Similarly, it was found that a student who does well in Fundamentals of Accounting, Quantitative Methods I and Business Law in first year has enhanced chances of being classified in the Accounting option, relative to classification in the non-accounting option, again all other factors remaining constant.

These results should be interpreted in consideration of other factors not specifically addressed in the study. A factor such as interest in a given option may override the student's need to merely excel in whatever option and may thus be more crucial in choice of an option. In this regard, the findings of the study should be viewed as a tool to aid in the choice of an option and not necessarily as a tool to be rigidly applied for those students proceeding to their second year.

CHAPTER 1

INTRODUCTION

1.1 Background

Currently, the Faculty of Commerce at the University of Nairobi has three options open to a student after completion of the first year of study at undergraduate level. These are the Accounting option, the Marketing option and the Insurance option. However, the latter two options are administered together under the Business Administration Department.

Upon completion of the first year, a student invariably faces a problem of choice on which option to take. This problem of choice is likely to be compounded when other options are introduced as has been suggested, beginning in the year 1990. The other options suggested for introduction are General Management, Management Science and Finance.

The courses offered in a given option are related as they are geared towards a particular specialisation. Needless to say, any student would like to pursue that option he would perform best in. As Astin (1971) has observed,

> "Nearly every student planning to go to college is concerned about how well he will do once he gets there. This concern relates not only to the grades he is likely to receive but also to his chances of staying in college through graduation."[1]

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[1] Astin, A.W.: Predicting Academic Performance in Colleges, The Free Press, N.Y., 1971, p. 3.

Astin's sentiments are corroborated in a study carried out by Jones (1979) at the University of Auckland, New Zealand. One of his findings was that a student is admonished by fellow students, parents, career advisors, liaison officers, relatives and friends thus: "don't fail". Jones goes further to state:

> "... subjects are chosen at University because it is hoped that they will add up to an easy course ... students take subjects because they are good at them (and choose them at school because they have thoughts of taking them at University). They expect not to fail; indeed, they expect to excel at, and enjoy these subjects."[2]

Thus, a major way of minimising chances of performing poorly is by choosing subjects that one is good at. Hence, it is entirely possible that the failure rates in some of the Faculty's examinations might be reduced if the choice of an option was done wisely, with the aid of empirically-determined (and tested) models. These failure rates were at one time so high that they were the subject of a senate investigating committee.[3]

Currently, the Faculty of Commerce gives strong advice to a student with less than a predetermined score in Fundamentals of Accounting and Quantitative Methods (both courses offered in first year) not to opt for Accounting. It is felt that this is too restrictive in terms of guiding a student in so far as the other options are

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[2] Jones, J.: "Student's Views on the Roles of a University", Higher Education, 8 (1979), p. 519.

[3] Kohler, Dr. D.: Ad Hoc Committee's Report on the High Failure Rates in Some of the Faculty's (Commerce) Examinations (1980).

concerned. This is mainly because neither those two subjects nor the cut-off scores have been objectively or empirically determined so that, it is largely true to assert that there is no objective way of counselling a student on whether or not to pursue a given option. As Onuong'a (1988) aptly puts it,

> "Though there are various methods of deriving a relationship between ... and performance, empirical analysis are the most widely used since they are testable as opposed to such simple methods as 'educated' or simple guesses." 4

Thus, the major thrust of this study is to attempt to identify determinants of performance in the Accounting vis-a-vis the non-accounting options in the Faculty. This is with a view to coming up with courses that distinguish between students who will do well in the Accounting option as opposed to those who will do well in the non-accounting options.

The University of Nairobi has been concerned at various times on student performance in the Faculty. For instance, in 1979, the University Senate appointed a committee to investigate the particularly high failure rates in some of the Faculty's examinations that year.[5] This was essentially a task force, so that the study was directed towards production of a specific report. The study,

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[4] Onuong'a, J.O.: An Evaluation of Pre-Entry Performance Predictors for Bachelor of Commerce Students at the University of Nairobi, Upublished M.B.A. Project, U.O.N., 1988, pp. 2 - 3.

[5] Kohler, Dr. D., op. cit.

however, did not concentrate on the relative performance of the various options per se but rather mainly considered the Faculty in totality.

The other study is a recent one (1988).[6] It was concerned with determining performance predictors in the Faculty's examinations. It is quite similar to the first study but more exhaustive. However, it also did not address itself specifically to the issue of performance in the various options, its major objective being to come up with pre-entry performance factors, the factors used being secondary school courses taken by the subjects of the study. The present study can be considered, in a way, to be a follow-up of that study since it acts mainly on the premise that the student is already admitted into the Faculty and is addressing himself or herself to the issue of which option to take in second year and beyond.

1.2 Statement of the Problem

As it has already been mentioned, students of the Faculty of Commerce have often found difficulty in choosing between various options offered in the Faculty after completion of their first year of study. The criteria that have been mainly used by the Faculty in guiding and counselling the students have been scores in various subjects in the first year of study. Specifically, the

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[6] Onuong'a, J.O.: op. cit.

Accounting Department has insisted on a score of at least 50% in Fundamentals of Accounting and 55% on Quantitative Methods for a student to be admitted into the Accounting option. None of these criteria have been objectively determined.

Further, there inevitably will be those students who take a given option, only to find later on that they were not well suited for it. It is often too late to revert to a suitable option for such a student. Yet, intuitively, one would imagine that there are a priori student attributes such as performance in various courses and examinations that best suits a given student in a given option.

There have also been suggestions as to the introduction of more options in the Faculty. In particular, the Faculty is poised to offer General Management, Management Science and Finance options, beginning 1990. Those students aspiring to take those options shall inevitably need some guidelines as to what type of student is likely to do best in each option. Even though the options to be introduced are not considered due to lack of data, at least accounting vis-a-vis non-accounting options will have been addressed. The results could be used to some extent, though. For instance, the Finance option will have a greater relationship to Accounting than to non-accounting options.

It is thus necessary to come up with predictor models that are able to predict the option where a given student

is best suited. Arriving at such models is practically not easy, though.

There are mainly two vexing issues that any researcher has to address himself to. One of these issues is with regard to the choice of predictor variables and the other is what type of statistical tool to employ.[7]

The criterion variable in this study was third year Grade Point Average (GPA), which was used to define the population of interest. It was felt that this was the best criterion of success for two reasons. Generally, students strive to achieve a high GPA while at University. This is because pursuance of higher educational studies require a specified minimum of performance in the GPA. Also, employers of the Faculty's students desire those students with high GPA.

The predictive variables selected are "O" level and "A" level aggregate scores, and the first year individual subjects, that is

Quantitative Methods
Business Studies
Introduction to Economics
Fundamentals of Accounting
Behavioural Science I
and Business Law.

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[7] See sections 1.5 and 2.2 for a greater discussion of these issues.

1.3 Importance of the Study

This study should be of benefit to certain parties and institutions. Firstly, it should provide an objective method for the wise selection of the option by the student concerned upon completion of the first year of study. Indeed, it should help those aspiring to join the Faculty of Commerce focus their attention at some particular option.

Also, those students with low grades in identified requisite subjects can also be helped through guidance and counselling in those subjects. The study should particularly be useful to this group of students, given their being weak in those courses.

The lecturers and tutors would also be dealing with a student lot which is best suited to the particular option. This would make their teaching work relatively easier. Other than these parties, other universities in Kenya or elsewhere with these options in their Faculty of Commerce programs, or intending to introduce them should also find the results of value.

Finally, it is hoped that this study would form a basis for further inquiry in this area. This is particularly for any phenomenon whereby the subjects are from given, defined group(s).

1.4 Objectives of the Study

This study is basically aimed at arriving at various variables that can effectively discriminate between a student

who is best suited to pursue Accounting option and one who is best suited for non-accounting courses. To this end, the study specifically aims at attaining two objectives.

The study aims to identify the variables, if any, that clearly distinguish between students who will perform well in the Accounting option as opposed to those who will perform well in the non-accounting options. Also, the study is aimed at determining the nature of the predictive/discriminative equation, if any, that can be used to predict whether a student would perform better in an Accounting or non-accounting course.

1.5 Choice of Predictor Variables

A recurrent problem in any empirical study such as the present one is with regard to the choice of "suitable" predictor variables. Conceptually, a logical starting point would be to pick predictor variables that have a cause - and - effect relationship with the criterion variable. As Green, P.E. et al (1988) observe,

> "... this is undoubtedly because we each have an innate desire to understand. Of a more direct and practical consequence, however, is the fact that if the causes of the effects we want to predict are understood, our ability both to predict and to control these effects is almost always improved."[8]

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[8] Green, P.E. et al, Research Methods for Marketing Decisions, Englewood Cliffs, N.J. Prentice-Hall Inc., 1988, p. 105.

However, this approach is not without limitations. Firstly, a causal relationship is quite difficult to establish. It requires vast accumulation of evidence from various investigations which, if all findings point to the same conclusion, increase our confidence that a causal relationship exists. But even then, it is rarely conclusive since variables may be either space or time specific (or both), so that a given predictor variable at some point in space or time may not be so in another, different point.

Further, a given phenomenon may be caused by a multitude of factors. These factors may not all be observable at the same time for all the subjects under study, as in the case of, for instance, one's input in terms of hours of study per given period (say per week) which is devoid of data for the present study, much as the researcher feels has a great bearing with the criterion variable.

Some variables, which may intuitively seem to be the most appropriate to use, may not be quantifiable. A factor such as one's interest or level of motivation for a course or future plans cannot be quantified, relevant though it may be for the purposes of this study.

Other variables, such as IQ tests and aptitude tests may be culturally-biased (culture-specific). As Kimura (1987) cautions,

> "It should be noted as a caution that the use of "extraneous" scores like IQ tests, aptitude tests, etc. has had its ample share of criticism, especially by social scientists who are of the view that such scores are heavily biased towards certain cultural attributes of the examiners and may, therefore, be unsuitable in a different environment."[9]

In any case, even if such variables were not culturally-biased, it would not be possible to obtain data for them in the case of this study as the subjects are no longer in the University, at least not as undergraduate students.

There are other variables which, even though they may have a high relationship with the criterion variable, cannot be used practically in making policy decisions. Mostly, this applies to such demographic factors as age, sex, race and so on where issues of discrimination arise. Thus, even though Kohler, Dr. D. (1980) found age and sex to be significant predictors of performance in the Faculty of Commerce, he cautioned that it would not only be illegal but also unfair to consider such demographic factors for admission purposes.

A further consideration with regard to choice of predictor variables to use in a model is economy. Ideally, as many explanatory variables as possible should be used to develop the model. However, marginal benefit from the inclusion of the "last few", relatively

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[9] Kimura, J.H.: An Evaluation of Performance Predictors for Accounting Option Students, Unpublished Research Proposal, U.O.N., 1987, p. 5.

unimportant variables may not justify the additional cost. As Kendall, M.G. (1975) points out,

> "... on the practical side, we may wish to reduce the number of variables to save computational effort; or we may wish to avoid variables which are expensive to observe, or involve a lot of delay in measurement, provided that nothing serious is lost in the purpose of the inquiry."[10]

What may be regarded as the "best" predictor variables may also be interrelated. This is the problem of multicollinearity. Thus, the variables having the highest correlation with the criterion variable when considered singly might contribute very little to that combination of the predictor variables which correlates most highly with the criterion. This is more of a problem in regression analysis as compared to discriminant analysis as observed by Paolillo, J.G.P. and Estes, R.W. (1982) thus:

> "multicollinearity is largely an irrelevant concern in discriminant analysis except where correlations are such that the dispersion matrices cannot be inverted."[11]

Notwithstanding the foregoing limitations on the choice of predictor variables, it is possible to utilise what variables are available and still obtain results that have a reasonable degree of accuracy for the purpose

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[10] Kendall, M.G.: Multivariate Analysis, Charles Griffin and Co., Ltd., London, 1975, p. 5.

[11] Paolillo, J.G.P. and Estes, R.W.: An Empirical Analysis of Career Choice Factors Among Accountants, Attorneys, Engineers and Physicians, "The Accounting Review", Oct. 1982, p. 787.

intended, such as predictive ability or classificatory power in the case of this study.

1.6 Outline of the Study

This project consists of six chapters. The foregoing chapter considered the background to the study, statement of the problem, objectives of the study, its significance and finally a discussion on choice of predictor variables.

Chapter two is devoted to the literature review. Consideration is given to a background on options offered in the Faculty of Commerce and Predicting Academic Performance. In Chapter three, the statistical tool used to analyse the data, linear discriminant analysis, is outlined.

The fourth chapter gives the research methodology used in the study and chapter five is devoted entirely to data analysis and a discussion of the results. Chapter six, the conclusion, gives a summary of the findings and their implications followed by a discussion on limitations of the study and finally, directions for further research in this area are contemplated.

CHAPTER 2

LITERATURE REVIEW

2.1 Background to Options offered in the Faculty of Commerce

At the time the Faculty of Commerce was formally established in the year 1964, it had four departments namely Accounting, Business Administration, Law and Economics. The Department of Law became a fully-fledged Faculty in 1970 whereas the Department of Home Economics was absorbed into the Faculty of Science.

The Faculty continued offering Accounting and Business Administration (Marketing) options until the academic year 1980/81 when the Insurance option, incorporated under Business Administration, was begun. However, only a small group of students each year have opted for Insurance since its inception. Thus, Accounting and Business Administration (Marketing) remain the dominant options, in terms of student preference, to date.

According to the Faculty of Commerce Programs Handbook[12], the Accounting option emphasizes the fundamental and advanced theoretical and practical issues of measurement, reporting and managing wealth both within and outside a business organisation.[13]

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[12] Faculty of Commerce: Programmes Handbook, U.O.N, Dean's Office, 1982.

[13] A listing of various courses under various options is given in appendix A.

The core courses offered in the second and third year of study in the Accounting option provide for a wide variety of careers, including the following:-

General and Financial Management; including portfolio management,

Public Accounting in both Government and Local Administrations with specialisations in Auditing, Taxation, Staff Training and Management Consultancy,

Management Accounting - both in the services and industrial sectors of the economy.

Additionally, for those students intending to pursue Accounting and Public Secretarial professional qualifications (such as C.P.A.(K), C.P.S.(K)), the option offers a wide range of courses among the electives available which would enable such students not only to meet the professional prequalification requirements, but also to obtain a substantial number of professional exemptions from the relevant examining bodies.

On the other hand, the Business Administration option (Marketing) is designed for students who have either not decided on a specialised area in management or who wish to prepare themselves for general administrative and management functional areas. The option combines both introductory and advanced courses in the areas of Marketing, Economics, Labour and Industrial Relations, Banking,

Personnel Management, Law, Management Science and Finance. It is not only intended to cater for those students seeking a broad exposure to several management functional areas but is also tailored to meet students' individual interests and objectives. The option avails to students a varied and wide ranging number of elective courses to enable them to elect a concentration area appropriate to their interests.

For students interested in general management careers, this programme offers to them a range of courses, which enables them to focus on those conceptual frameworks and analytical tools, both qualitative and quantitative, most applicable in executing complex corporate policy strategies and decisions in varied economic, social, cultural, legal and technological environments.

Additionally, for students opting for the Business Administration specialisation, further functional area specialisation is available in Marketing, Industrial and Labour Relations, Banking and Cooperative Management. These specialised areas are not independent options as such, so that the student specialises in them by way of choosing related subjects/courses among the electives (see appendix A). All these courses are geared towards specific management careers once a student graduates from the program.

The Insurance option prepares students taking it for courses in the insurance industry. It is a relatively new option, compared to Accounting and Marketing which have been offered since the Faculty started. As with any other new course, its inception was in response to the need for highly trained personnel in the field of insurance in order to cope with the needs of the fast growing insurance industry, particularly in Kenya.

The Insurance option is a highly specialised one, covering such courses as Elements of Risk and Insurance, Introduction to Insurance Law, Assurance of the Person, Property Insurance, Liability Insurance and Elements of Actuarial Science, aside from the electives (see appendix A). As in Accounting or Marketing, by "combining" the electives in a suitable manner, a student taking this option can choose an area of functional specialisation such as Marine Insurance, Life Assurance, Motor Vehicle Insurance and so on. Due to the rapid expansion of the Faculty (it had only fifty undergraduate students in 1964 compared to over nine hundred registered in the academic year 1988/1989), it is intended to have Insurance option upgraded into a fully-fledged department.

Other than the above mentioned three options, the Faculty, in response to the demands by the external environment, is set to introduce new options from the

academic year 1990/1991. These options are General Management, Management Science and Finance.

As might be expected, the choice of an option is largely dependent on the student himself. However, as has been noted already, the Department of Accounting has over the years insisted on high scores for students intending to pursue the Accounting option in Fundamentals of Accounting and Quantitative Methods.

2.2 Predicting Academic Performance

The literature surveyed in this section lays emphasis on the variables that were used and the methodology. A shortcoming, however, is that most of the studies reviewed were carried out either in the United States of America or in Britain. The main reason is that there are very few related studies in this area that have been carried out in Kenya. Indeed, no study known to this author has been carried out in this area that uses discriminant analysis techniques, which are used in this study. Nevertheless, this shortcoming is mitigated to some extent given that the Kenyan educational system has a lot of similarity to those of the United States and Britain. As Mbeche, I.M. (1979) has pointed out,

> "... although the studies are from the two countries mentioned (USA and Britain), their education systems are closely related to the Kenyan system of education ... much of the literature used in our teacher training institutions are mainly from the United States and Britain."[14]

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[14] Mbeche, I.M.: An Investigation into Factors Contributing to Teaching Effectiveness Among Student Teachers, Unpublished M.A. Thesis, U.O.N., 1979, p. 10.

Frakes, A.H. (1977)[15] carried out a study in the United States in an attempt to correlate introductory accounting objectives and intermediate accounting performance. He used both correlation and regression analysis on equal sized samples drawn from Washington State University and University of Washington. His most important conclusion was that other than accounting achievement test results, other variables, notably demographic factors such as sex and age had also a high relationship with the criterion variable, which was performance in intermediate accounting. Thus, in attempting to explain performance in some given course, it may be inadequate to limit oneself to only those variables which are, or obviously seem to be, directly related to the criterion.

Ave Astin

The findings of the above author support those of an earlier study carried out by Astin (1971)[16] on "Predicting Academic Performance in Colleges". He concluded that there are three major predictors of academic success in colleges. These are

high school performance
aptitude tests
and sex.

The study was, however, carried out in the United States where aptitude tests are administered prior to entry for

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[15] Frakes, A.H.: "Introductory Accounting Objectives and Intermediate Accounting Performance", The Accounting Review, Jan. 1977.

[16] Astin, A.W.: op. cit.

a course at University. Such tests are not administered at the Faculty of Commerce.

Gatumu (1976),[17] in his study on the ability of O-Level, A-Level and an Aptitude test to predict performance at the University of Nairobi as measured by the final year GPA also found aptitude test to be quite significant. Apart from factor and canonical analysis, he also used regression analysis. The subjects of that study were drawn from various faculties of the University (Commerce was not one of them).

Perhaps the most pertinent finding from that (Gatumu's) study is that different predictor variables were more significant in one faculty relative to the others. May be this should not be surprising in that subject requirements for entry into the university differ across faculties. Intuitively, this finding can be extended to the case of options offered at the Faculty of Commerce, so that one would expect different a priori subject requirements for the different options.

Dockweiller and Willis (1984)[18] in their study concerning entry requirements for undergraduate accounting programs also used the final year GPA as the criterion variable. The subjects of their study were students at the Faculty of Accounting of the University of Missouri. They

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[17] Gatumu, H.J.N.: A Study of Predictive Validity of O-Level, A-Level and an Aptitude Test in Relation to the Performance at the University of Nairobi, Unpublished M.A. Thesis, U.O.N., 1976.

[18] Dockweiller, R,C. and Willis, C.G.: "On the use of Entry Requirements for Undergraduate Accounting Programs", The Accounting Review, July, 1984.

analysed the data by way of correlation and regression analysis. From an original set of eleven predictor variables, they found that the criterion variable was highly correlated to the first and second introductory accounting courses prior to entry into the faculty, and also to the student's overall GPA before entering the accounting program.

Further, the same authors found that college aptitude test scores also had a positive correlation with performance although this was much lower than the correlation between the first and second grades in introductory accounting courses and performance. Age had a high correlation with the criterion, also, which tends to support the findings by Frakes (1975) and Kohler, Dr. D (1979) much as it may not be practical to use such demographic factors for certain policy decisions, such as admission to certain courses.

The authors further carried out a discriminant analysis for the three most significant variables, the purpose being to assess the validity of these variables. They achieved an 81% success rate in terms of predicting the true group of an individual case, which, they contended, was a great success since "any set of admission standards can be expected to result in some screening errors."[19]

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[19] Ibid p. 502.

Young, W.C.

Young, W.C.E. (1975)[20] used discriminant analysis when distinguishing between the relative performance of (1) Boys and girls and (2) Arts-based students and science-based ones in certain psychological tests administered. The students were drawn from some selected Kenyan high schools.

Among the findings were that the discriminant function was significant for the boys-girls case whereas it was not so for the arts-science analysis. This was at 5% level of significance. Out of the three psychological tests administered, the boys were found to outperform the girls in two of them. This shows that even in such natural groups (defined by sex), there are certain tests that one group would be, on the average, better than the other and vice versa. In the case of relative performance among the various options in the Faculty of Commerce, it is possible that, out of those who ultimately do well, the same case as that of the boys-girls referred above could very well be the case in so far as their common subjects are concerned.

Paolillo, J.G.P. & Estes.

A study which perhaps has a great bearing to the present one was carried out by Paolillo, J.G.P. and Estes, R.W. of University of Wyoming and Wichita State University respectively in 1982.[21] The problem of the study was whether, given other careers, accountants had, a priori,

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[20] Young, W.C.E., "Relationship Between Scores on Creativity Tests, School Examination Marks and Teacher's Assessment of Creativity", in Modern Psychology and Cultural Adaptation (Edited by F.M. Okatcha), Swahili Language Consultants and Publishers, Nairobi, 1977.

[21] Paolillo, J.G.P. and Estes, R.W., op. cit.

any similarities (or differences) in their considerations of what career to pursue. They collected primary data by use of questionnnaires. The subjects of study were required to respond to a number of Likert-type statements in an attempt to tap twelve factors, which were then used for the analysis.

Due to non-conformity of the data to certain conditions of linear discriminant analysis, these authors used quadratic discriminant analysis.[22] They found the following factors to be the major considerations for the accountants:

1. Availability of employment
2. Earnings potential
3. Years of formal education required
4. Aptitude for the subject
5. Teacher influence

The following factors were not significant for them:

Parental influence

Cost of education

Job satisfaction

Peer influence

The most significant consideration in the choice of career for attorneys was found to be social status while teacher influence and availability of employment were found

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[22] See Chapter 3 for an exposition on the assumptions of linear discriminant analysis.

to be insignificant considerations.

Mechanical engineers had availability of employment as the greatest factor to consider whereas social status was rated low, a converse of the attorneys' situation.

Physicians, on the other hand, were found to rate the following factors highly:

Parental influence

Job satisfaction and

Peer influence

whereas the following ones were rated low in their decision regarding the choice of a career:

Earnings potential

Previous work experience and

Aptitude for the subject.

Clearly, the above mentioned study shows that when considering the choice of a career, whether someone shall eventually end up in one or some other career can be dependent not only on courses done in college or aptitude for them but also on behavioural considerations, such as interest, influence of others and so on. These are the very considerations, already mentioned elsewhere, as the possibly relevant factors but not quantifiable.

In the Faculty of Commerce itself, two studies related to student performance have been carried out. The first one was done in 1979 by a senate investigating committee.[23]

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[23] Kohler, Dr. D., op. cit.

It was prompted by what senate termed "the high failure rates" in some of the Faculty's examinations. The committee used a sample of 104 students from the 1976 intake of students. Their criterion variable was third year GPA. They analysed the data using correlation analysis and t tests.

Their findings support those of some of the authors already discussed in this review, particularly concerning demographic factors. Apart from other findings, they concluded that males do better than females on the average; younger students tend to do better than older ones and that Mathematics was strongly positively correlated with GPA. It was also found that the Accounting students tended to perform better than their colleagues in Business Administration in most quantitative courses where these are common, such as in Quantitative Methods I in first year. The two groups of students did not have much difference in the non-quantitative courses, however. This might be a pointer as to what might be expected in this study in terms of the most appropriate discriminating variables.

Onuong'a, J.O. (1988)[24] did a study regarding performance predictors for students in the Faculty of Commerce. He developed two regression equations using two samples of size 100 each. The reason he ran two regressions was so as to arrive at consistently significant predictor

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[24]Onuong'a, J.O. (1988), op. cit.

variables, thus overcoming, or at least minimising, the chances of including time-specific variables in the model. After developing the model, he used a further sample of 100 students to validate it, and achieved 88% prediction, within 95% confidence interval.

The above mentioned author's findings were that success in the Faculty (as measured by the final year GPA) had a high correlation with mathematics, commerce and science, aside from such demographic variables as age and sex (though sex was only significant in one regression). The study thus supports those mentioned already in so far as demographic factors are concerned, as predictors of academic performance. He also, like Kohler, Dr. D. (1979) does, cautions on the problem of use of demographic variables in certain policy decisions such as admission into some courses.

Other than the choice of predictor variables, it is thus evident also from the literature that it is possible to use discriminant analysis techniques, even if not to predict the actual performance of a student, to at least categorise such a student into some group with some "reasonable" degree of predictive accuracy, "reasonable" being dependent on the researcher's objectives. To paraphrase Neter and Wasserman (1974), discriminant analysis can thus be used as a prescreening device for students best suited for Accounting option as opposed to those best suited for non-accounting ones.

CHAPTER 3

THE MODEL

3.1 An Outline of Discriminant Analysis

The major statistical tool that is used in this study is linear discriminant analysis, a variant of ordinary least square regression analysis. Even then, t-tests will be carried out for each variable firstly. This is to screen, and possibly abandon, any variable that does not show a significant difference between accounting and non-accounting students. It was necessary to carry out the t tests since stepwise procedures for discriminant analysis would not be possibly carried out.

Discriminant analysis begins with the desire to statistically distinguish between two or more a priori defined groups of cases. These "groups" are defined for the particular research situation. To distinguish between the groups, the researcher selects a collection of discriminating variables that measure characteristics on which the groups are expected to differ.

The mathematical objective of discriminant analysis is to weight and linearly combine the discriminating variables in such a manner that the groups are forced to be as statistically distinct as possible. Specifically, this is achieved by finding linear combinations of the predictor/

discriminating variables that maximise among-groups relative to within groups variation.

The general form of the discriminant equation is:

$$Z_i = K_{i1}X_1 + K_{i2}X_2 + \text{---} + K_{in}X_n$$

where Z_i is the score on discriminant function i

the K_{ij}'s are the weighting coefficients

and the X_{ij}'s are the values of the n discriminating variables used in the analysis.

In the case of a two-group discriminant analysis, the discriminant function is one. However, if there are more than two groups, it is possible to get more than two discriminant equations. Specifically, the maximum number of functions which can be derived is either one less than the number of groups or equal to the number of discriminating variables, if there are more groups than variables (an unlikely situation, though).

The fact that there can be more than one discriminant equations in an analysis may present problems of interpretation. This is so because the various weights taken by predictor variables may not be consistent, from one equation to the other, when ranking these variables in terms of relative importance. Even if they were consistent in this aspect, a given case may not be consistently placed in the same group by all the equations.

A way out of this problem is given by the eigenvalue

of the equation, a statistic which gives the relative importance of each of the equations (in the case of a two-group analysis, the relative importance of the equation would obviously be 100%). In any case, this problem of multiple discriminant equations is not of major concern in the present study as it involves a two-group analysis.

For one reason or another, a researcher may be faced with what he may consider to be too many variables. He may for example be interested only in a certain number of variables which passes a specified level of significance in the discriminant equation.

There are a number of ways of dealing with this problem.[25] A method already mentioned is by screening the variables by use of a t test at a desired level of significance (depending on the objectives of the study). The variables can be ranked using this test so that the larger the t value is, the better a discriminator the variable is likely to be. This technique, however, does not consider the interrelationship between the variables.

The variables can also be ranked using the initial discriminant function coefficients, that is, by using the standardized coefficients of the function that includes all the variables (the full model). The use of the coefficients of the full model is questionable, though. The coefficients of a reduced model could, for instance,

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[25] See, for instance, Goldstein, M. and Dillon, W.R.: Discrete Discriminant Analysis, John Wiley and Sons, N.Y., 1978.

be used in ranking the variables. Yet, different combinations of the variables do not necessarily result in the same or consistent ranking of these varibles. This again is due to interrelationship of the variables as in the case of the preceeding t test approach, which is likely to be different for different combinations.

Variables can also be screened by way of linear multiple regression. The various groups are considered as sub-populations and for each of them, a regression equation is worked out. The relative importance of each predictor variable in each group can then be assessed, say by way of its marginal contribution to the coefficient of determination (R^2) in the regression. The variables, already found relatively important, and different for the groups, would then be the most discriminating.

The discriminant function can also be computed using a stepwise regression program that introduces variables one at a time. The criterion for entry at each stage is to select that variable that reduces the residual sum of squares as much as possible. Clearly, this is the most appropriate technique when compared with those already discussed.

Statistical significance of discriminant functions is tested by a variety of methods. One statistic that is used is the Mahalanobis squared distance which is transformed into an F-ratio.

Another widely used measure for testing statistical significance in discriminant analysis is the canonical correlation coefficient. This measure summarizes how related the discriminant function is to the groups. Thus, the higher it is, the higher the significance of the equation and hence, the more efficient it is as a discriminator.

An indirect, and most widely used approach to test for the significance of the discriminant function is Wilks' Lamda (also called the U statistic). It is calculated such that values of lambda near zero indicate high discrimination, and when it is equal to its maximum value of unity, the group centroids are equal and thus there is no discrimination.

Wilks' Lamda can also be transformed, albeit only as an approximation, into a chi-square statistic. This provides an easy test for statistical significance. The approximation holds good for most situations. Marriott (1974) has observed thus:

> "This approximation is adequate for most practical purposes, and the simplicity and flexibility of the chi-square leads to tests of subsidiary hypotheses that are more valuable than the general test."[26]

Now, computer software differ so that not all computer outputs give all the various statistics to assess

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[26] Marriott, F.H.C.: The Interpretation of Multiple Observations, Academic Press, Inc., London, 1974, p. 29.

the significance of a discriminant equation. Hence, apart from any other considerations, the significance testing statistics used for a given problem will be dictated by the nature of computer programs available. At any rate, these statistics are fairly consistent so that the use of many or all of them would merely be superfluous.

3.2 Assumptions of the Model

The statistical theory of linear discriminant analysis is based on two major assumptions. Firstly, the variables being used are assumed to have a multivariate normal distribution. Secondly, these variables are assumed to have equal variance-covariance matrices within each group.[27]

Various methods for testing the data for conformity to these assumptions are available.[28] In the event that any or both of these assumptions are not fulfilled, certain distortions in the results may occur.

If multivariate normality assumption is violated, tests of significance and estimated classification error rates may be biased. The more critical assumption, however,

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[27] There are further two assumptions that are germane to linear discriminant analysis when assigning new cases: the probability of a new case falling into each of the groups, and the cost of misclassification are both assumed to be equal across the groups. These will be discussed in the next section.

[28] See for instance, Marriott, F.H.C. (1974), op. cit., pp. 16 - 17 or

Andrews, D.F. et al: "Methods of Assessing Multivariate Normality", in Multivariate Analysis-III - 1972 Conference on Multivariate Analysis, Dayton, Ohio (edited by Krishnaiah, P.R.), pp. 95 - 115.

is that of the equality of group dispersion (i.e. variance-covariance) structures across all groups. Violation of this condition affects several aspects of discriminant analysis such as significance tests for the differences in group mean vectors, and the appropriate form of the classification rule itself.

There are two methods to resort to in situations where these assumptions are violated, depending upon which assumption is concerned.[29] In the case where multivariate normality is justified but not equality of group dispersion, then the use of quadratic discriminant analysis is preferred. Where both the assumptions are violated, recourse is to some distribution - free methods of discrimination.

A situation where either multivariate normality is violated but equality of dispersion matrices is not or where both of them are violated, though possible, is very remote. As Marriott (1974) puts it, "it is hardly realistic".[30]

Much as it is generally advisable to test data for non-violation (or otherwise) of these requisite conditions,

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[29] For a detailed study of these methods, see Marriott, F.H.C. (1974), op. cit. pp. 38 - 39 or
Dillon, W.R.: "The Performance of the Linear Discriminant Function in Non-optimal Situations and the Estimation of Classification Error Rates: A Review of Recent Findings", Journal of Marketing Research, 16 (Aug. 1979), pp. 370 - 381.

[30] op. cit., p. 39.

in practice, linear discriminant analysis is very robust and these assumptions need not be strongly adhered to, particularly if the assumption of equality of dispersion matrices holds good. Marriott (1974) notes:

> "The assumption of normality is seldom justified, but the central limit theorem (in the multivariate case) ensures robustness for almost any distribution in which the variance is independent of the mean (or of group membership)."[31]

In any event, t tests will be carried out in this study to assess the violation, if any, of these conditions.

3.3 Use of the Model in Prediction

The use of discriminant analysis as a classification technique or for prediction comes after the initial computations and statistical significance tests have been performed. Before it can be used for this purpose, however, validation of the model is imperative.

One way of validating the model is by use of the initial sample, that is, the sample used to develop it in the first place. As can be surmised, this approach is inherently biased; thus, one would expect a relatively high degree of validity.

The other approach for validation is by use of fresh data, or a hold-out sample. The total sample available

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[31] Ibid p. 37.

is divided into two sub-samples. One of these sub-samples is used to develop the model and the other is used to cross-validate it. This is the better approach as it is expected to capture variables which have stable significant coefficients.[32] It is only after this cross-validation procedure that the model can legitimately be used for classification of new cases whose group membership are not known. Ideally, though, the use of a series of samples is the best method. This is limited in practice in that samples are usually small and thus cannot be sub-divided beyond a certain limit.

Other than the assumptions already alluded to elsewhere in this study, classification of a new case requires two further assumptions; that the probability of a new case falling into each of the groups and the cost of misclassification are each assumed equal across the groups. There are computer packages that can be used in the case where these assumptions may not have been met. Since there is no a priori defined class size for the different options in the Faculty of Commerce, the assumption of equal chance of a new case falling into each of the groups will be taken to hold for the purposes of this study.

Misclassification in this study can occur in two ways. One way is where a student who should have been classified

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[32] See Neter et al (1985), Crask and Perreault (1977) and Hora and Wilcox (1982).

into the Accounting option is instead classified into the non-accounting options. The other is the reverse situation where a student who should have been classified into a non-accounting option is put into the Accounting one. There is no reason to suppose that there is a difference in the relative costs of these errors. Thus, equality of costs of classification errors across the groups will also be taken to hold.

The classification of a given subject into a given group is not a clear-cut issue. A case is merely assigned to that group which it has the highest probability of falling into. This is achieved by use of a separate linear combination of the discriminating variables for each group.

This problem of classification lies in the borderline or marginal cases where the probabilities of a case falling into one or the other group(s) are practically the same. Some authors, notably Kendall (1975)[33] have suggested ways of dealing with these situations, such as using a different criterion to disentangle such closely-related cases. At worst, reservation of judgement would be inevitable, that is, a situation of inability to classify a particular case. Given a discriminant function, however, it is highly unlikely to find a case whose chance of falling into any one of the groups is exactly equal across all the groups.

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[33] Kendall, M.G.: Multivariate Analysis, Charles Griffin and Co. Ltd., London, 1975.

Among other output, computer programs for discriminant analysis give the discriminant function coefficients (both standardized and unstandardized) and the group classification functions. Either of these two outputs can be used to classify a case. In the case of the discriminant function, the one with the unstandardized coefficients is used together with the raw scores of the variables, as the scores have not been put to a common scale. The rule is to assign a case to that group whose centroid is nearest to the discriminant score of the case.

For the group classification functions, the rule is to assign the case to that group whose (the case's) score is highest. This is equivalent to assigning the case to that group where it has the highest probability of falling into. These two approaches are merely two ways of achieving the same end as they could never be contradictory. The discriminant function score approach will be used in this study, in classifying the cases in the holdout sample (validation sample).

CHAPTER 4

RESEARCH DESIGN

4.1 The Population

The population of interest in this study consisted of all those students who were successful in the Faculty of Commerce between the calendar year 1979 and 1988, a period of eight academic years.[34] Although data was available from the year 1964 when the Faculty was begun, to date, the latter period was chosen mainly due to the ease of data accessibility. The period chosen is anyway long enough so that the study should be able to adequately capture variables that are not time-specific, if any.

The term "successful" requires some explanation. It is used here in a restricted sense. Thus, for the purposes of this study, a successful student is defined to mean a student who graduates with an Upper Second Class Honours degree or above, so that the criterion of success is performance in the University examinations, as given by the third year GPA of a student.

If university examinations are viewed as a means to an end rather than an end in themselves, then the more appropriate measure of success would be subsequent performance of a student after

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[34] The number of academic years is less than the number of calendar years due to the problems of frequent closures that the University experienced within the given time span.

entering a chosen career. Due to the difficulty of accessing the subjects this way, the university examination criterion was chosen as the best surrogate.

There are two reasons for taking Upper Second Class or above as criterion of success. Firstly, given the Kenyan setting where job opportunities are very competitive, most employers of the Faculty's students seek those students with at least an Upper Second Class Honours degree. Secondly, most students strive to excel in the examinations and to meet the requirements for most higher educational studies such as M.B.A. which require at least an Upper Second Class degree.

The defined population consists of subjects who are likely to have done well in most of their academic undertakings. This is so because admission into a higher stage of education normally requires high performance (mainly as measured by way of examinations) in the preceeding stage. For instance, admission for O-level studies requires high levels of performance at primary school level. Similarly, to be admitted into A-level and University, one should have passed well in O-level and A-level examinations respectively. This is mainly due to the competitive nature of the available places at each subsequent stage as there normally are more applicants than the number of places available so that it is not sufficient to meet the minimum entry requirements. That

the subjects in the defined population not only managed to go through all stages to University but also obtained Upper Second Class Honours degree finally attests to their high likelihood of having done well in most of their examinations.

4.2 The Sampling Procedure

The defined population has been divided into two groups of four academic years each. The first group, between the academic years 1979/80 and 1983/84 inclusive, has been used to develop the model. The second group, beginning the academic year 1984/85 till 1987/88, has been used to cross-validate it. Consequently, the samples for the analysis have been drawn from these two periods. This is an appropriate technique in order to overcome problems of sample-specific characteristics as suggested elsewhere in this report. The use of an earlier period to develop the model and a latter one to validate it is so as to counter the problem of stationality, if any.

In sampling, the following formula was used, in each category, to determine the sample size:

$$n = \frac{z^2 s^2}{E^2}$$

where n = number of subjects

z = reliability factor

s = population standard deviation

and E = maximum tolerable error.

As the population parameters are not known, it was necessary to carry out a pilot study to estimate them. The reliability factor was set at 95% level of confidence; hence z = 1.96. Thus, the maximum tolerable error, which is defined as half the reliability factor, is 0.98.

A convenience sample of forty students for each group was picked from the first four academic years that the study covered (1979/80 to 1983/84). An equal size of ten for each year, in each group, was selected. Their final year GPA was used in the pilot study whereby their means and standard deviations were calculated.

The results were:

Mean GPA for accounting students = 63.78

Sample standard deviation = 3.59

Adjusted[35] standard deviation = 3.64

Mean GPA for non-accounting students = 62.99

Sample standard deviation = 3.15

Adjusted standard deviation = 3.19

The adjusted standard deviation was used in computing the sample sizes.

For the accounting students, the sample size is:

$$n = \frac{(1.96)^2(3.64)^2}{(0.98)^2} = 53.0$$

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[35]The adjustment for the standard deviation is to obtain an unbiased estimate of the population standard deviation based on the sample standard deviation by applying the correction factor,

$$\sqrt{\frac{n}{n-1}}$$ where n is the sample size

For the non-accounting students, the sample size is:

$$n = \frac{(1.96)^2(3.19)^2}{(0.98)^2} = 40.7$$

Equal sized groups in discriminant analysis yield more accurate results than unequal sized ones. Thus, the sample size of the group with the larger number, accounting, was rounded upwards to 60. Consequently, a sample size of 60 was used for each group.

Depending on the number of students in a given year falling into the defined population, a proportionate sample size was picked, for each group, using a systematic random procedure to determine the total of 60. Systematic random selection was possible as student files are arranged alphabetically in the Faculty of Commerce's archives.

Thus, the total sample size for all the eight years was 240 as each group had 120; the first lot being for model development and the second one being for model validation.

4.3 Data Collection

All data used in this study is secondary data. All of it was obtained from the Records Office of the Faculty of Commerce, University of Nairobi. Since the final year GPA is the criterion variable, it was one of the data points sought. The discriminating/predictive variables are first year GPA and all the first year individual subjects, that is

Quantitative Methods I

Business Studies

Introduction to Economics

Fundamentals of Accounting

Behavioural Science I

and Business Law.

"O" and "A" level aggregate scores were also included. The study had also, initially, proposed to use the subject combinations of a student, that is, whether a student was arts-based or science-based in school. However, this variable was dropped as practically all the students included in the sample had done arts courses in school (out of the entire sample of 240, only thirteen students had done science-based courses).

Since the interest of the study was with regard to pre-entry performance factors, the use of second year or third year course results (post-entry) would obviously not serve any useful purpose in so far as the objectives of this study are concerned. Further, as has been noted elsewhere, other possibly pertinent factors had to be excluded on grounds of their immesurability or data deficiency.

Some of the data collected was not available in readily usable form and had to be transformed. The O-level aggregate is computed from the student's different subjects. The six best subjects are used to compute the aggregate.

The performance in O-level per subject is assessed by

awarding a grade between 1 and 9 as follows:

1 - 2	Distinction
3 - 6	Credit
7 - 8	Pass
9	Fail

Therefore, the lower the score, the better the performance. The sum of the six best subjects thus formed the O-level aggregate. The range for the aggregate for an individual in O-level is thus six points at best and 54 points at worst.

The A-level aggregate is also obtained by adding the scores of the individual subjects taken. Unlike in the case of O-level, however, all the subjects are taken into account. The results are given in the form of grades A to F and these grades are assigned points thus:

A	=	6
B	=	5
C	=	4
D	=	3
E	=	2
O	=	1
F	=	0

Grades A to E are regarded as "principal passes" while grade O is subsidiary pass. Grade F is fail. The sum of all the scores in individual subjects at A-level was taken to be the A-level aggregate. The range is thus 19 points at best (3 principal subjects) or 25 points

(4 principal subjects) or zero points at worst. Note that there is one compulsory subsidiary subject, General Paper, which has a maximum score of one point.

The first year course results are given as a percentage, ranging from a minimum of zero score to a maximum of a hundred. GPA, which is a linear combination of all the first year courses, is also given as a percentage. Specifically, GPA is a weighted average of the first year courses, with the full courses being assigned a weight of 1.0 and half courses being assigned a weight of 0.5.[36] This data pertaining to first year courses and the GPA was collected in the form it was and was not transformed.

Among the first year courses, two of them are half courses and the rest are full courses.[37] The half courses are Business Studies and Behavioural Science I. The full courses are

Introduction to Economics
Business Law
Fundamentals of Accounting
and Quantitative Methods I.

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[36] See Appendix B for examination regulations

[37] See Appendix A

However, no adjustment need be carried out to reflect this fact since the interest of the study is with regard to the group a student would best be suited for rather than on the performance in the university examinations per se. Moreover, first year courses are not included in determination of final year GPA. Furthermore, the Faculty of Commerce has now fully used the semester system in its first year studies so that distinction for first year courses as half course or full course no longer exists.

Final year GPA is used to categorise the class of degree a student passes in. Generally, the rule is as follows:

70 and above - First Class Honours
60 - 69 - Second Class Honours (Upper Division)
50 - 59 - Second Class Honours (Lower Division)
40 - 49 - Pass

A student getting a GPA below 40% would not qualify for a degree. Thus, the students whose data was collected for this study had final year GPA of at least 60%.

4.4 Data Analysis Methodology

Having grouped the students on the basis of their third year GPA, samples of size 60 in each category was used to develop a discriminant model using the following variables:

O level aggregate
A level aggregate
Introduction to Economics
Business Law

Fundamentals of Accounting

Quantitative Methods I

Business Studies

Behavioural Science I

and GPA for first year.

The data was analysed by use of the statgraphics package in the COMPAQ microcomputer. This package gives a wide range of statistical analytical tools. Among these tools, there are two-sample analysis (t tests) and discriminant analysis which were used in this study.

For the t tests, the confidence interval for the equality of variance and hypothesis test for the equality of group means for each variable is given as ouput in one table. " Discriminant analysis output begins with the means for each group for every variable." Then, the standard deviations of each of these variables for each group are given. Next are given the group classification function coefficients, followed by the standardized and unstandardized coefficients of the discriminant equation(s).

The various statistics for assessing the significance of the discriminant function are then given. These are the eigenvalue, the canonical correlation, Wilks' Lamda and the chi-square. Lastly, the group centroids are presented.

Before discriminant analysis was done, certain preliminary analysis were conducted. t tests were carried

out to assess the equality of variances for each variable between the groups. For the condition of multivarite normality, no test was performed as none was available in the computer package. As has been seen elsewhere, however, it is quite unrealistic for groups to have equal dispersion matrices and yet not to be multivariate normal. Hence, the variables were assumed to be multivariate normally distributed.

Further t tests were carried out to screen the variables individually for their discriminating power. Again, the superior method of stepwise discriminant analysis, much as it would have been preferable as it takes into account the interrelationship of the variables at each step, was not available. Discriminant analysis was then performed with what were found, on the basis of the t test, to be the "optimum" set of variables.

Statistical significance of the discriminant function was tested using the Wilks' Lamda criterion (transformed into the chi-square statistic). Canonical correlation and eigenvalues were also used in the discussion of the results.

In the model validation phase, the discriminant function coefficients were used to place the cases in the validation sample. As already noted, since there is no a priori defined class size for accounting or non-accounting groups in the Faculty of Commerce, nor is there any reason

to suppose differences in costs of classification errors across groups, the assumptions of equal probability of being placed in either group and of equality of misclassification costs across the groups are adopted. No "borderline" or "gray" area was defined, so that each case was placed in one and only one of the two groups.

CHAPTER 5

DATA ANALYSIS AND FINDINGS

5.1 Introduction

In this chapter on data analysis and findings, t tests are carried out, firstly in order to assess the equality of variances for the variables for the two groups, Accounting option and non-accounting option. Secondly, t-tests are done to screen those variables which are not significantly different between the two groups as they would not be suitable for the development of a discriminant model.

Discriminant analysis is then performed using variables that were found to have significant differences in their means between the two groups. In the final phase, validation of the model developed is done using a hold-out sample. For most of the data analysis, significance level was set at $\alpha = 0.05$.

The variables used in the analysis can be placed into three categories. In the first category are those variables before the student enters university, and these are the O-level aggregate and A-level aggregate. The second category is composed of first year scores in individual courses. These courses are

Introduction to Economics

Business Law

Fundamentals of Accounting

Quantitative Methods I

Business Studies

and Behavioural Science I.

The first year GPA can also be regarded as a separate category. This is because it is a linear combination of all the first year courses mentioned above. This categorisation of the variables is useful in discussing the results.

The following symbols were used to represent the variables.

Variable	Symbol
O-level aggregate	OLEV
A-level aggregate	ALEV
Introduction to Economics	ECON
Business Law	BLAW
Fundamentals of Accounting	FACT
Quantitative Methods I	QM
Business Studies	BSTUD
Behavioural Science I	BSCI
Grade Point Average for year I	GPA1

The Accounting option is referred to as group 1 and the non-accounting options are referred to as group 2.

5.2 Two Sample Analysis

5.2.1 Equality of Variance Tests

The test for equality of variances across the two

groups was performed with the following guiding hypotheses:

Null hypothesis (H_o): There is no difference in the variances of the variables between the two groups.

Alternate Hypothesis (H_1): There is a difference in the variances of the variables between the two groups.

The test was done by finding the 95% confidence interval for the ratio of the variances in group 1 and group 2. The results are summarized in Table 5.1.

TABLE 5.1: CONFIDENCE INTERVAL FOR RATIO OF VARIANCES

VARIABLES	95% CONFIDENCE INTERVAL		STATISTICAL DECISION
	UPPER LIMIT	LOWER LIMIT	
O-LEV	0.650	1.821	Fail to reject H_0
A-LEV	0.623	1.747	"
ECON	0.820	2.298	"
BLAW	1.000	2.804	Reject H_0
FACT	0.687	1.925	Fail to Reject H_0
QM	0.519	1.455	"
BSTUD	0.498	1.395	"
BSCI	0.459	1.288	"
GPA1	0.441	1.237	"

Thus, except for Business Law, all the variables had 1 included in the confidence interval, a result that would be expected if the variances for the two groups were equal for a given variable. Even for Business Law, 1 is just on the margin (at the lower limit). Indeed, the 99% confidence interval for the ratio of the variances for this variable is 0.872 to 2.932, and hence including 1. So, it cannot be concluded that the variances of the variables in the two groups are different. In fact, it can be inferred that there is some evidence that these variances may be equal between the groups for a given variable.

Although comparison of covariance matrix values across the groups is not done, the result obtained above for the equality of variances, though by no means conclusive on the assumption of equality of dispersion matrices between the two groups, is nevertheless a strong indicator of their possibly being equal. It cannot be overemphasized that the test just performed is only a partial one.[38]

Variance-covariance matrices for the two groups for all the variables are presented in Tables 5.2 (i) and 5.2 (ii).

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[38] A complete test on equality of dispersion matrices across groups can be carried out utilizing Box's M statistic and its associated F test.

TABLE 5.2 (i): VARIANCE-COVARIANCE MATRIX FOR GROUP 1

	OLEV	ALEV	ECON	BLAW	FACT	QM	BSTUD	BSCI	GPA1
OLEV	26.27	-1.67	-4.09	4.47	-12.74	-1.79	-14.99	-0.13	-4.46
ALEV		2.27	0.29	2.07	0.87	6.75	-1.38	0.80	1.96
ECON			61.55	-8.11	20.61	19.19	15.07	3.62	19.95
BLAW				71.36	-10.23	2.21	-6.86	1.01	11.49
FACT					54.25	19.87	18.27	1.86	18.50
QM						119.84	-19.46	1.84	30.65
BSTUD							54.04	10.27	7.73
BSCI								26.78	5.44
GPA1									17.55

TABLE 5.2 (ii): VARIANCE-COVARIANCE MATRIX FOR GROUP 2

	OLEV	ALEV	ECON	BLAW	FACT	QM	BSTUD	BSCI	GPA1
OLEV	25.18	-2.03	-4.71	0.49	-2.53	4.04	3.53	-2.18	-0.35
ALEV		2.09	0.57	0.69	1.19	3.32	-0.55	0.37	1.13
ECON			44.85	10.69	15.84	53.90	16.11	1.65	26.73
BLAW				42.61	-3.15	28.44	-6.36	-7.34	14.37
FACT					47.18	19.81	24.08	13.03	19.61
QM						137.95	6.59	-3.66	48.24
BSTUD							64.85	5.73	15.06
BSCI								34.83	4.91
GPA1									23.75

A casual comparison of these variances and covariances shows that, though they are not exactly equal for a given variable, most of them carry the same sign and are of the same order. The variances tested for their equality are

those in the leading diagonals.

Thus, even though the above analyses are not conclusive, they do not provide any evidence on the violation of the equality of variance-covariance matrices. So, this condition will be taken to hold. Hence, the variables can be used to develop a linear discriminant model (at least as far as this condition is concerned), as opposed to a quadratic one which would be the case if there was gross violation of this condition.

5.2.2 Equality of Means Tests

t tests for equality of means for the variables were carried out in order to abandon those variables found not to be significantly different between the groups. They were performed under the following hypotheses:

Null Hypothesis (H_0): There is no difference in means of a given variable between group 1 and group 2, i.e. $\mu_1 = \mu_2$.

Alternate Hypothesis (H_1): There is a difference in means of a given variable between group 1 and group 2, i.e. $\mu_1 \neq \mu_2$.

Level of significance is set at $\alpha = 0.05$ and the

results of this test are summarized in Table 5.3 (iii) below. The variable means and standard deviations are given in Tables 5.3 (i) and 5.3 (ii) respectively.

TABLE 5.3 (i): GROUP MEANS

VARIABLE	GROUP 1	GROUP 2
OLEV	17.283	18.900
ALEV	14.617	14.333
ECON	63.800	56.367
BLAW	57.883	53.967
FACT	66.500	51.150
QM	72.450	55.033
BSTUD	60.600	60.383
BSCI	61.783	60.567
GPA1	64.407	55.400

TABLE 5.3 (ii): GROUP STANDARD DEVIATIONS

VARIABLE	GROUP 1	GROUP 2
OLEV	5.126	5.018
ALEV	1.508	1.446
ECON	7.846	6.697
BLAW	8.447	6.528
FACT	7.366	6.869
QM	10.947	11.749
BSTUD	7.351	8.053
BSCI	5.086	5.901
GPA1	4.190	4.874

TABLE 5.3 (iii): TEST FOR EQUALITY OF MEANS

VARIABLE	T VALUE	STATISTICAL DECISION
OLEV	-1.746	Fail to reject H_0
ALEV	1.051	"
ECON	5.582*	Reject H_0
BLAW	2.842*	"
FACT	11.806*	"
QM	8.394*	"
BSTUD	0.154	Fail to reject H_0
BSCI	1.036	"
GPA1	10.855*	Reject H_0

* = significant at $\alpha = 0.05$

Hence, the most significant variables in order of t value, are:-

Fundamentals of Accounting
GPA for first year
Introduction to Economics
Quantitative Methods I
and Business Law.

These variables are the ones that would be expected to be the most discriminating between the two groups and will thus be used in developing the discriminant model.

The variables that are not significant between the two groups, in descending order (with the least significant first) are:-

Business Studies

Behavioural Science I

A-level aggregate

and O-Level aggregate.

The failure of O-level and A-level aggregate to differ between the two groups should not be a surprising result. This is so because admission into the University is based on A-level performance and to some extent, the O-level performance since a student must have obtained at least five credits in O-level as one of the prerequisites for entry into University. Similarly, admission into A-level is based on O-level scores. Thus, these students were not randomly selected, since, as far as O-level and A-level performance are concerned, all of them are already equally good performers in these two courses and hence are not significant in discriminating between the groups.

It is difficult to understand why Business Studies and Behavioural Science I are not significant. They are, however, among those non-quantitative variables that the senate investigating committee's study (1980) also found not to be significant among the two groups although the population for that study included all students in the Faculty in the period covered and not only the "successful" ones. Further, this result obtains in spite of the sample of that study having been drawn from a different year (1976). Clearly, these two variables are not likely

to be time-specific.

5.3 Model Development

This section on model development starts with the discriminant model which includes all the variables regardless of whether they were found to differ significantly between the two groups or not. This was necessary so as to facilitate comparability and thus, a discussion of the results. This model will be referred to as Full Model I.

A slightly reduced model, with all the variables included except GPA for first year, is formulated next. This is further to enhance discussion of the results. This model is referred to as Full Model II.

A model using only those variables found to differ significantly between the two groups is formulated next. This model is referred to as Reduced Model I. A further reduced model which includes those variables found to differ significantly between the two groups with the exception of GPA follows. This is the optimal model and will be referred to as Reduced Model II. GPA, being a linear combination of the first year courses, is likely to distort results. It is for this reason that some analysis carried out excludes it.

To further facilitate a discussion of the findings and comparability, those variables found not to differ significantly between the two groups were used alone for

a discriminant model. These variables are

O-level aggregate

A-level aggregate

Business Studies

and Behavioural Science I.

This model will be referred to as Reduced Model III. Thus, in total, there are five discriminant models developed.

5.3.1 Full Model I (with GPA)

The results of the discriminant function derived by inclusion of all variables are shown in tables 5.4 (i) through to 5.4 (iii).

TABLES 5.4 (i) - 5.4 (iii): DISCRIMINANT MODEL: FULL MODEL I

TABLE 5.4 (i): CLASSIFICATION FUNCTION COEFFICIENTS

VARIABLE	GROUP 1	GROUP 2
OLEV	1.725	1.747
ALEV	6.798	7.107
ECON	2.891	3.167
BLAW	3.403	3.624
FACT	3.060	3.022
QM	2.081	2.291
BSTUD	1.787	2.036
BSCI	2.819	2.962
GPA1	-11.080	-12.527
CONSTANT	-216.818	-199.006

TABLE 5.4 (ii): SIGNIFICANCE STATISTICS

STATISTIC	VALUE
EIGENVALUE	1.718
CANONICAL CORRELATION	0.795
WILKS' LAMBDA	0.368
CHI-SQUARE	113.477
GROUP CENTROIDS: GROUP 1	1.300
GROUP 2	-1.300

TABLE 5.4 (iii): DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	COEFFICIENT	
	STANDARDIZED	UNSTANDARDIZED
OLEV	-0.044	-0.008
ALEV	-0.176	-0.119
ECON	-0.768	-0.105
BLAW	-0.637	-0.084
FACT	0.109	0.015
QM	-0.907	-0.080
BSTUD	-0.737	-0.096
BSCI	-0.302	-0.055
GPA1	2.512	0.553
CONSTANT	-	-6.852

The means for the various variables indicates a consistently higher score for the accounting group vis-a-vis the non-accounting group (table 5.3(i). However, except for Quantitative Methods I, Business Studies, Behavioural

Science I and GPA for First Year, the standard deviations for the accounting group is consistently higher than for the non-accounting group (table 5.3 (ii)). It would be incorrect to make any conclusions based on the mean alone as it does not take into account the variability and interrelationship between the variables. Furthermore, the variables are not standardized and hence, they are not on a common scale.

The standardized discriminant function (table 5.4 (iii) is

$$Z = -0.040\ OLEV - 0.176\ ALEV - 0.768\ ECON - 0.637\ BLAW + 0.109\ FACT - 0.907\ QM - 0.737\ BSTUD - 0.302\ BSCI + 2.512\ GPA1$$

where Z is the discriminant score.

The unstandardized discriminant function is

$$Z = -0.008\ OLEV - 0.119\ ALEV - 0.105\ ECON - 0.084\ BLAW + 0.015\ FACT - 0.080\ QM - 0.096\ BSTUD - 0.055\ BSCI + 0.55\ GPA1 - 6.852$$

The group centroids are:

Group 1 = 1.300

Group 2 = -1.300

The discriminant function derived with all the variables included is highly significant, with $\chi^2 = 113.477$ (critical value of χ^2 with 9 degrees of freedom and $\alpha = 0.05$ is 16.919) [table 5.4 (ii)].

The canonical correlation is also quite high, being 0.795 whereas Wilks' Lambda for the equation is low, at 0.368. All these statistics point to the high discriminating power of the model.

The order of discriminating power per individual variable can be obtained from table 5.4 (iii) (the standardized discriminant function coefficients). It is only the absolute value which matters as discrimination can be either way as the group centroids are on either direction of the line-number continuum from zero. Thus, the ranking of the variables (with the most discriminating first) is

GPA
Quantitative Methods I
Introduction to Economics
Business Studies
Business Law
Behavioural Science I
A-level aggregate
Fundamentals of Accounting

and finally, O-level aggregate.

As already noted elsewhere, GPA is a linear combination of the first year results. These results should thus be interpreted with skeptism as distortions are likely to be present. Such distortion could, for instance, account for the radically different ranking

of the variables, compared with the ranking given by the t test.

In terms of classifying an individual case, the higher the score in all variables except O-level aggregate, Fundamentals of Accounting and GPA1, the more likely for that case to be classified into a non-accounting course, all other factors held constant (table 5.4 (i). This is in spite of the group means which show contrary results. This lends further weight to the likelihood of these results being distorted.

5.3.2 Full Model II (without GPA)

In order to address the problem of distortion of results due to GPA seen in the preceeding section, discriminant analysis was performed using all variables except GPA. The results are presented in tables 5.5 (i) to 5.5 (iii).

TABLE 5.5 (i) - (iii): DISCRIMINANT MODEL: FULL MODEL II

TABLE 5.5 (i): CLASSIFICATION FUNCTION COEFFICIENTS

VARIABLE	GROUP 1	GROUP 2
OLEV	1.748	1.772
ALEV	7.042	7.383
ECON	0.790	0.791
BLAW	1.074	0.992
FACT	0.852	0.526
QM	-0.169	-0.253
BSTUD	0.668	0.771
BSCI	1.629	1.617
CONSTANT	-215.609	-197.461

TABLE 5.5 (ii): SIGNIFICANCE STATISTICS

VARIABLE	VALUE
EIGENVALUE	1.707
CANONICAL CORRELATION	0.794
WILKS' LAMBDA	0.369
CHI-SQUARE	113.540
GROUP CENTROIDS: GROUP 1	1.296
GROUP 2	-1.296

TABLE 5.5 (iii): DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	COEFFICIENT	
	STANDARDIZED	UNSTANDARDIZED
OLEV	-0.048	-0.010
ALEV	-0.194	-0.132
ECON	0.004	0.001
BLAW	0.240	0.032
FACT	0.896	0.126
QM	0.368	0.032
BSTUD	-0.308	-0.040
BSCI	0.025	0.005
CONSTANT	-	-7.003

The standardized discriminant function obtained is

Z = -0.048 OLEV - 0.194 ALEV - 0.004 ECON + 0.240 BLAW
+ 0.900 FACT + 0.368 QM - 0.308 BSTUD + 0.025 BSCI

The unstandardized discriminant function is

Z = 0.010 OLEV - 0.132 ALEV - 0.001 ECON + 0.032 BLAW
+ 0.126 FACT + 0.032 QM - 0.040 BSTUD + 0.005 BSCI
- 7.003

The significance of this slightly reduced model remains substantially the same as for the Full Model I case (table 5.5 (ii). The chi-square is 113.540, being slightly higher than for Full Model I. The loss in discriminating power can be assessed by a comparison of the significance test statistics. Such a comparison is given in table 5.6 below.

TABLE 5.6: COMPARISON OF FULL MODEL I AND II ON SIGNIFICANCE

STATISTIC	FULL MODEL I	FULL MODEL II	% CHANGE $(\frac{I-II}{I})$
Eigenvalue	0.718	1.707	0.6
Canonical Correlation	0.795	0.794	0.1
Wilks' Lambda	0.368	0.369	-0.3
Chi-square	113.477	113.540	-0.1
Group Centroid	1.300	1.296	0.3

The eigenvalue and the canonical correlation went slightly down, by 0.6% and 0.1% respectively whereas Wilks' Lambda went up by 0.3%. The group centroid neared zero by 0.3%. All these changes indicate a very slight reduction in terms of the discriminating power of the variables without GPA1. It should be appreciated here that generally, the more the variables included in a discriminant model, the higher the discriminant power of the model, even if the relative contributions of the variables differ.

When the order of classificatory power of the individual variables is taken into account, a significant change is observed between Full Model I and Full Model II. The order for Full Model II is as follows (table 5.5 (iii):

Fundamentals of Accounting

Quantitative Methods I

Business Studies

Business Law

A-level aggregate

O-level aggregate

Behavioural Science I

and Introduction to Economics.

It is seen that Fundamentals of Accounting, which was the second least discriminant in Full Model I, is now the best one in spite of little difference in overall discriminating power of the two models. Similarly, Introduction to Economics, which was the third best discriminator, is now the least whereas Behavioural Science I loses its relative importance. O-level aggregate, which was the least discriminating variable in Full Model I, has now assumed quite some importance.

The nature of distortion is likely to be the relatively high discriminating power of GPA alone vis-a-vis the other variables, so that it "absorbed" most of the discrminating capacity. Relative to the second most important variable in the model (Quantitative Methods I), it was about 2.8 times as important, thus leaving relatively little difference between the two groups, that was not yet accounted for.

All other factors held constant, an individual case has a higher chance of being placed in Accounting as compared to non-accounting if it has higher scores in the following variables (table 5.5 (i).

0-level aggregate

Business Law

Fundamentals of Accounting

Quantitative Methods I

and Behavioural Science I.

On the other hand, a case is more likely to fall into the non-accounting group relative to the accounting one if the score is higher in the following variables:

A-level aggregate

Introduction to Economics

and Business Studies.

It is not possible to determine the relative importance of these variables as outlined above as they are not measured on a common scale. Nevertheless, the results give a different picture from that given by Full Model I, which included GPA. Three courses, Business Law, Quantitative Methods I and Behavioural Science I, which in Full Model I, the higher the scores in those courses the higher the likelihood of a case being classified into a non-accounting course relative to an Accounting one, have now changed. This is further evidence of the distorting nature of GPA. For all the variables, significant or not significant, then, this model can be regarded as the best one.

5.3.3 Reduced Model I - Model with Significant Variables

The preceeding model (full model without GPA), though appropriate, contains variables which were not found to

differ significantly between the two groups. These variables are likely to contribute only marginally in a discriminant model. Thus, it may not be an optimal model as such.

To work towards an optimal model, significant variables are used to develop it. These variables are

Introduction to Economics

Business Law

Fundamentals of Accounting

Quantitative Methods I

and GPA for first year.

The results of this analysis are presented in tables 5.7 (i) to 5.7 (iii).

TABLE 5.7 (i) - (iii): DISCRIMINANT MODEL: REDUCED MODEL I

TABLE 5.7 (i): CLASSIFICATION FUNCTION COEFFICIENTS

VARIABLE	GROUP 1	GROUP 2
ECON	-1.367	-1.457
BLAW	-0.784	-0.963
FACT	-1.193	-1.603
QM	-1.656	-1.832
GPA1	9.417	9.909
CONSTANT	-137.334	-116.046

TABLE 5.7 (ii): SIGNIFICANCE STATISTICS

STATISTIC	VALUE
EIGENVALUE	1.601
CANONICAL CORRELATION	0.785
WILKS' LAMBDA	0.384
CHI-SQUARE	110.404
GROUP CENTROIDS: GROUP 1	1.255
GROUP 2	-1.255

TABLE 5.7 (iii): DISCRIMINANT FUNCTION COEFFICIENTS

VARIBLE	COEFFICIENTS	
	STANDARDIZED	UNSTANDARDIZED
ECON	0.261	0.036
BLAW	0.538	0.071
FACT	1.164	0.163
QM	0.795	0.070
GPA1	-0.890	-0.196
CONSTANT	-	-8.483

The standardized discriminant function is

$$Z = 0.261\ ECON + 0.538\ BLAW + 1.164\ FACT + 0.795\ QM - 0.890\ GPA1$$

The unstandardized discriminant function is

$$Z = 0.036\ ECON + 0.071\ BLAW + 0.163\ FACT + 0.070\ QM - 0.196\ GPA1 - 8.483$$

The function is significant, though there is some loss in discriminating power as compared with the model that includes all variables and the one excluding only GPA. To assess the extent of this loss, comparative figures are given in table 5.8 below. The figures are comparative for what is regarded as the best model, that is, the full model excluding GPA with the model which includes only the significant variables.

TABLE 5.8: COMPARISON OF FULL MODEL II AND MODEL WITH SIGNIFICANT VARIABLES

STATISTIC	FULL MODEL II	MODEL WITH SIGNIFICANT VARIABLES	% CHANGE $\frac{(A-B)}{(A)}$
	A	B	
Eigenvalue	1.707	1.601	6.2
Canonical Correlation	0.794	0.785	1.1
Wilks' Lambda	0.369	0.384	-4.1
Chi-square	113.540	110.404	2.8
Group Centroid	1.296	1.256	3.1

It can be noted that the various statistics give different levels of reduction in the discriminating ability of the model. However, even if we were to be conservative and hence adopt the greatest change in these statistics (that of the eigenvalue), then it

would only amount to 6.2%. The other measures of significance indicate only slight changes. In particular, the more appropriate of these measures, the canonical correlation, Wilks' Lambda and Chi-square have only changed by 1.1% , 4.1% and 2.8% respectively. The two group centroids have both approached zero by an extent of only 3.1%.

It can thus be asserted that the change from the full model excluding GPA to the one with only significant variables is not great at all. This may have been expected as the variables excluded are those not found to differ much between the two groups in terms of their group means.

The relative importance of the variables in terms of their discriminating power for this model can be discerned from table 5.7 (iii) (standardized coefficients). The ranking is as follows (beginning with the most important):

- Fundamentals of Accounting
- GPA for first year
- Quantitative Methods I
- Business Law

and Introduction to Economics.

Apart from GPA which was not in Full Model II, the other variables are ranked consistently as in that model (excluding only GPA).

All other factors held constant, an individual case has a higher probability of being placed in accounting the higher the score in all variables except GPA for first year, whereby the higher it is, the more likely for a case to be placed into a non-accounting course. Again, this is contrary to the results of the group means, particularly for GPA, where GPA is ranked third in terms of differences in group means (it is the first in terms of differences of the standardized scores and second according to the t test for group means). Even though the mean scores per se are not a sufficient indicator of discriminating power of a variable, one would nevertheless be wary of this result. This finding lends further credence to the distorting nature of GPA when used in conjunction with first year course results. Thus, the results from this model may not be very reliable.

5.3.4 Model with Significant Variables Excluding GPA

Due to the problems with GPA already seen, a further refinement in the model was considered necessary. The variables found to be significant with the exception of GPA were used in this model, which is considered the optimal model. The results are laid out in tables 5.9 (i) to 5.9 (iii).

TABLE 5.9 (i) - (iii): DISCRIMINANT MODEL: REDUCED MODEL II

TABLE 5.9 (i): CLASSIFICATION FUNCTION COEFFICIENTS

VARIABLE	GROUP 1	GROUP 2
ECON	0.743	0.764
BLAW	1.128	1.048
FACT	1.179	0.892
QM	0.036	-0.051
CONSTANT	-96.843	-71.219

TABLE 5.9 (ii): SIGNIFICANCE STATISTICS

STATISTIC	VALUE
EIGENVALUE	1.545
CANONICAL CORRELATION	0.779
WILKS' LAMBDA	0.393
CHI-SQUARE	108.355
GROUP CENTROIDS: GROUP 1	1.233
GROUP 2	-1.233

TABLE 5.9 (iii): DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	COEFFICIENT	
	STANDARDIZED	UNSTANDARDIZED
ECON	-0.060	-0.008
BLAW	0.243	0.032
FACT	0.827	0.116
QM	0.403	0.035
CONSTANT	-	-10.395

The standardized discriminant function is

$$Z = -0.060\ ECON + 0.243\ BLAW + 0.827\ FACT + 0.403\ QM.$$

The unstandardized function is

$$Z = -0.008\ ECON + 0.032\ BLAW + 0.116\ FACT + 0.035\ QM - 10.395$$

Even though GPA for first year, a seemingly high discriminating variable, has been dropped, the function with the four variables is still highly significant, with $\chi^2 = 108.355$. Thus, not much loss in terms of discriminating power of the function is sustained. This position can be further appreciated with a comparative analysis of the two models as outlined in table 5.10 below. The table also gives values for the assessment of difference between the optimal model and the full model which excluded GPA (Full Model II).

TABLE 5.10: COMPARISON OF OPTIMAL MODEL WITH FULL MODEL II AND MODEL WITH ALL SIGNIFICANT VARIABLES

STATISTIC	FULL MODEL II (A)	REDUCED MODEL I (B)	OPTIMAL MODEL (C)	% CHANGE 1 $\frac{(A-C)}{A}$	% CHANGE 2 $\frac{(B-C)}{B}$
Eigenvalue	1.707	1.601	1.545	9.5	3.5
Canonical Correlation	0.794	0.785	0.779	1.2	0.1
Wilks' Lambda	0.369	0.384	0.393	-6.5	-2.3
Chi-square	113.540	110.404	108.355	4.6	1.9
Group Centroid	1.296	1.256	1.233	4.7	1.8

A comparison of the optimal model with Full Model II shows a maximum loss in significance, as measured by the eigenvalue, of under 10%. The more reliable statistics for measuring significance, that is canonical correlation, Wilks' Lambda and Chi-square give a reduction in significance of 1.2%, 6.5% and 4.6% respectively while the centroid approaches zero by 4.7%. This reduction in significance is not very large, though, when compared with the number of variables dropped from Full Model II to this optimal model.

Further, the change from the model with significant variables (Reduced Model I) to the optimal model is very slight, being much less than the change from Full Model I to Full model II (table 5.8). The eigenvalue gives a change of only 3.5%, whereas the canonical correlation reduces by 0.1%. Wilks' Lambda, chi-square and the group centoids change by 2.3%, 1.9% and 1.8% in that order.

It is evident then that even if GPA is excluded from the significant varibles, not much loss in discriminating power of the discriminant equation occurs. This is in spite of the apparently high discriminating power of GPA between the two groups, already noted elsewhere. Given that the relatively insignificant variables have been excluded from this model, together with GPA (with its distorting effects), this model can then be regarded as the optimal model, out of all the four models already

discussed. It is the model that can thus finally be used in distinguishing between students who perform well, as measured by their final year GPA, in the Accounting option and in the non-accounting options. This is with a minimum number of variables (they are only four, out of the original total of nine).

The ordering of the variables as indicated by their discriminating power for the optimal model is as follows (with the most discriminating first) (table 5.9 (iii):

Fundamentals of Accounting
Quantitative Methods I
Business Law
and Introduction to Economics.

These results are consistent with those given by Full Model II, even though that model included the insignificant variables (but without first year GPA, though significant).

For classification of individual cases, the higher the score in three of the four variables, the greater the likelihood of such a case falling into Accounting option, ceteris paribus (table 5.9 (i). These variables are

Fundamentals of Accounting
Business Law
and Quantitative Methods I.

The higher the score in Introduction to Economics, ceteris paribus, the higher the probability of such a case being classified in a non-accounting option.

It should be noted that Fundamentals of Accounting and Quantitative Methods I are courses that are quantitative. It will not be an unexpected finding that those students who do well in them (in relative terms) are likely to also do well in the Accounting option (which is relatively more quantitative than the non-accounting option). These are also the same subjects that the Faculty emphasizes for a student wishing to pursue Accounting option upon entering second year.

The case of Business Law being an important discriminant for success in Accounting option is a surprising result. It is not a quantitative subject; indeed, it would have been expected that it would show no difference between the two groups, at worst. At best, one would have expected that students who eventually do well in the non-accounting options (which are relatively less quantitative compared to Accounting option) would have down well in Business Law in the first year. It is rather difficult to rationalise this finding.

5.3.5 Model with Insignificant Variables Only

To get further insight on the relative unimportance of the variables screened by the t test for equality of means between the two groups, a discriminant model is attempted using these variables only. The variables are

O-level aggregate

A-level aggregate

Business Studies

and Behavioural Science I.

The results are given in tables 5.11 (i) and 5.11 (ii).

TABLE 5.11 (i) - (ii): DISCRIMINANT MODEL: REDUCED MODEL III

TABLE 5.11 (i): SIGNIFICANCE STATISTICS

STATISTIC	VALUE
EIGENVALUE	0.039
CANONICAL CORRELATION	0.193
WILKS' LAMBDA	0.963
CHI-SQUARE	4.423
GROUP CENTROIDS: GROUP 1	-0.195
GROUP 2	0.195

TABLE 5.11 (ii): DISCRIMINANT FUNCTION COEFFICIENTS

VARIABLE	COEFFICIENT	
	STANDARDIZED	UNSTANDARDIZED
OLEV	0.733	0.144
ALEV	-0.251	-0.170
BSTUD	0.113	0.015
BSCI	-0.509	-0.092
CONSTANT	-	4.615

The standardized discriminant function is

$$Z = 0.733\ OLEV - 0.251\ ALEV + 0.113\ BSTUD - 0.509\ BSCI$$

The unstandardized discriminant function is

$$Z = 0.144\ OLEV - 0.170\ ALEV + 0.015\ BSTUD - 0.092\ BSCI + 4.615.$$

The function, with a chi-square of 4.423, is not significant as the critical value of chi-square with 4 degrees of freedom and $\alpha = 0.05$ is 9.488. Indeed, the other statistics for assessing statistical significance attest to this. The canonical correlation is very small, being only 0.193 and Wilks' Lambda, at 0.963, approaches unity whereby the two groups would be homogeneous, that is, there would be no distinction between them.

Similarly, the group centroids, at an absolute value of 0.195, almost merge at zero, indicating virtually no distinction between the two groups. It can thus be rightly concluded that these four variables do not discriminate between the two groups, at least not when they are combined alone in a discriminant model.

5.4 Model Validation

Having screened the variables that do not discriminate significantly between the two groups, accounting and non-accounting and having excluded GPA for first year due to its being determined from the first year courses, the optimal model with only four variables, is then validated. The four courses are

Introduction to Economics
Business Law
Fundamentals of Accounting
and Quantitative Methods I.

The discriminant function used is that which gives unstandardized coefficients of the variables (table 5.9 (iii). This is the appropriate function to use as the scores of the variables are not themselves standardized.

The equation is

$$Z = -0.008\ ECON + 0.032\ BLAW + 0.116\ FACT + 0.035\ QM - 10.395.$$

The group centroids are equal in absolute terms. They are

Group 1 (Accounting)	=	1.296
Group 2 (non-accounting)	=	-1.296

A case is assigned to that group where its discriminant score is nearest to that group's centroid. Since this is a two group analysis where sample size is equal and the probability of a case falling in either group together with error of misclassification between the two groups are assumed equal, the dividing line between the two groups is zero. For that matter, a case with a discriminant score higher than zero is classified in Accounting whereas one with a score less than zero is classified in non-accounting group.[39]

The classification of individual cases is given in appendix C and the summary results are presented in

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[39] Where these assumptions are not met, the centroids can be adjusted to reflect this situation.

table 5.12 below.

TABLE 5.12: CONFUSION MATRIX FOR HOLD-OUT SAMPLE

		PREDICTED GROUP MEMBERSHIP	
ACTUAL GROUP	NO. OF CASES	GROUP 1	GROUP 2
GROUP 1	60	46	14
		76.7%	23.3%
GROUP 2	60	9	51
		15.0%	85.0%

Percent of "Grouped" cases correctly classified = 80.8%.

It can be seen from table 5.12 above that the correctly classified cases for Accounting group is 46, representing a percentage of 76.7% whereas for non-accounting, the correctly classified cases is slightly higher, being 51 and thus giving a percentage of 85.0%. The overall correct classification rate is 80.8%.

Given that the data used for classifying the cases came from a different sample other than that used to develop the model, the correct classification rate of slightly over 80% can be said to be very high. Indeed, the individual cases in the hold-out sample can be considered as new cases since it was drawn from a different (latter) time span from the model development sample. It can thus be deduced that the model has a very high degree of predictive ability. Hence, it can legitimately be used in predicting where new cases are likely to fall; whether in the Accounting option or in a non-accounting course.

CHAPTER 6

CONCLUSION

6.1 Summary of Findings and Recommendations

The major objective of this study was to identify the variables that clearly distinguish between students who will perform well in the Accounting option as opposed to those who will perform well in the non-accounting options. This was mainly with a view to using these variables to help students upon entering second year of their studies at the Faculty of Commerce in choosing an appropriate option.

The first chapter discussed the problem of the choice of options which students face in the Faculty of Commerce just prior to entering their second year. In chapter five, various discriminant models were developed with the ultimate aim of coming up with suitable predictor variables that may be useful in guiding students when choosing their options.

For the model which was considered optimal, four courses taught in first year were found to be the most discriminating between Accounting option and the non-accounting option. These courses are

Fundamentals of Accounting

Quantitative Methods I

Business Law

and Introduction to Economics.

It was found that a case is more likely to be classified in accounting relative to non-accounting, the higher the score in each of the three courses, all other factors held constant. These courses are

Fundamentals of Accounting

Quantitative Methods I

and Business Law.

Similarly, it was found that, ceteris paribus, a case is more likely to be classified in a non-accounting option the higher the score in Introduction to Economics.

The results for the case of Accounting option are fairly consistent with the advice currently given by the Department of Accounting to those students wishing to take that option except for one course, Business Law. This subject could hence be used as one of those to help guide a student on whether or not to pursue accounting.

It may be difficult to suggest cut-off scores that may be used to admit students into the various options as the population used for the study composed of only those students who did very well in their final year. Nevertheless, it is possible to suggest a general guiding principle. To that effect, the more important a subject is in determining relative performance between the Accounting versus non-accounting options, the greater the weight it should be given. Specifically, for the Accounting option, the order of importance for the

subjects is

Fundamentals of Accounting

Quantitative Methods I

and Business Law.

For the non-accounting options, Introduction to Economics contributes to the chance of being classified in those options more than the other subjects, ceteris paribus.

It cannot be overemphasized that it can be quite erroneous to form an opinion on where a student is best suited on the basis of only one course. The model developed can only rightly be used to classify an individual case when all the courses used to develop it are considered.

Also, these findings should be used in the light of limitations of the study enountered. These limitations are the subject of the next section where suggestions for further study in this area are also given.

6.2 Limitations of the Study and Suggestions for Further Research

It is difficult to conduct a study such as this without any limitations. A major limitation encountered in this study is with regard to the discriminant variables used. As already seen elsewhere, some variables that could have been used either do not have data at present or are not quantifiable.

For instance, a variable such as interest of a student for a given option might be a crucial discriminating variable but its measurement was not possible. It is suggested that possibly a study utilising primary data that can tap a factor such as level of interest for a given option can be carried out. Other than interest, other behavioural factors such as level of motivation, influence and so on can be included in such a study.

Another limitation in this study pertains to data analysis. Stepwise discriminant analysis procedures which are superior to other procedures of screening insignificant variables were not used in this study. Surrogate procedures were used instead. It is suggested that the same study could be replicated, possibly with inclusion of more variables and stepwise discriminant analysis procedures utilised.

Similarly, the conditions for use of linear discriminant analysis techniques were not rigorously appraised in this study. In particular, the assumption of multivariate normality should have been assessed but due to unavailability of requisite tools of assessment, they could not be.

This study used only two groups, that is Accounting and non-accounting options. No distinction was made between the Marketing and Insurance options (though both are non-accounting options). This was due to unavailability

of data in sufficient quantities in the case of the Insurance option. In this regard, a study for two or more groups can be conducted when data is available and when the other options are introduced as already reported elsewhere in this study.

APPENDIX A

Undergraduate Courses offered in the Faculty of Commerce

The Undergraduate Programme of Study

A. Regulations for the Bachelor of Commerce Degree (B.Com.)

The Faculty of Commerce offers a three-year course leading to the Degree of Bachelor of Commerce (B.Com.) as a first degree.

Entry Requirements

1. A candidate for the degree of Bachelor of Commerce must satisfy the minimum entrance requirements for entry into the University and have a credit in Mathematics in K.C.E. or its equivalent.

Course of Study

2. A candidate will be examined in the equivalent of five full papers in his first year; five full papers in his second year and six full paper in his third year. A full paper represents a three-hour examination and a half paper, a two-hour examination.

B. Syllabus for the Bachelor of Commerce Programme

The Syllabus for the Bachelor of Commerce programme contains the following courses:

FIRST YEAR

Required Half Courses

DAC101 Foundations of Accounting
DAC102 Basic Accounting Practice
DBA103 Introduction to Economics - Microeconomics
DBA104 Introduction to Economics - Macroeconomics
DBA105 Business Law I
DBA106 Business Law II
DBA107 Business Studies
DBA108 Behavioural Science I
DMS109 Management Mathematics I
DMS110 Management Mathematics II

SECOND YEAR

Required Half Courses

DAC203 Managerial Accounting
DAC204 Finance I
DBA205 Economic Theory - Microeconomics
DBA206 Economic Theory - Macroeconomics
DBA207 Behavioural Science II
DBA208 Organisation Theory
DMS211 Computing Science I
DMS212 Business Statistics I

Accounting Option

DAC201 Accounting for Assets
DAC202 Accounting for Liabilities

Business Administration Option

The equivalent of one full course from list of approved electives.

Insurance Option

DIN213 Elements of Risk & Insurance
DIN214 Introduction to Insurance Law

Approved Electives

DAC201 Accounting for Assets (non-accounting option only)
DAC202 Accounting for Liabilities (non-accounting option only)
DBA209 Principle of Marketing
DIN213 Elements of Risk & Insurance(non-insurance option only)
DIN214 Introduction to Insurance Law(non-insurance option only

THIRD YEAR

Required Half Courses

DBA309 Business Policy and Decisions
DBA310 Special Topics in Business Policy

Accounting Option

DAC301 Specialised Financial Accounting Techniques
DAC302 Advanced Financial Accounting Practice
DAC303 Auditing Principles and Procedures
DAC304 Auditing Practice and Investigations
DAC305 Taxation
DAC306 Cost Accounting

Electives

The equivalent of two full courses.

Business Administration Option

Electives

The equivalent of five full courses.

Insurance Option

DBA209 Principles of Marketing (second year course)
DIN328 Liability Insurance I
DIN329 Liability Insurance II
DIN330 Assurance of the Person I
DIN331 Assurance of the Person II
DIN332 Property Insurance
DIN333 Elements of Actuarial Science

Electives

The equivalent of one full course

Approved Electives

DAC307 Finance II
DAC308 Accounting Theory
DBA311 Marketing Research
DBA312 Selected Applications of Marketing Research
DBA313 Banking Practice
DBA315 Company Law
DBA316 International Marketing
DBA317 Labour Relations
DBA318 Labour Law
DBA319 Management of Co-operatives
DBA320 Management of Human Resources
DBA321 Problems in Management for Human Resources
DBA322 Introduction to Econometrics
DBA323 Demographic Statistics
DMS324 Quantitative Methods II
DMS325 Business Statistics II
DMS326 Computing Science II
DMS327 Systems Analysis
DIN334 Aviation Insurance
DIN335 Marine Insurance
DIN336 Life Insurance
DIN337 Pension Schemes I
DIN338 Pension Schemes II
DIN339 Insurance of Transportation I
DIN340 Insurance of Transportation II
DIN341 Consequential Loss Insurance
DIN342 Risk Theory
CEC206 Comparative Economic Systems
CEC207 Comparative Economic Systems
CEC300 Economic Development
CEC301 Economic Development
CEC304 Agricultural Economics
CEC305 Agricultural Economics
CEC306 Economics of Industry and Labour
CEC307 Economics of Industry and Labour
CEC308 Money, Banking and Finance
CEC309 Money, Banking and Finance
CEC310 International Economics
CEC311 International Economics

A student may select as a elective course a required course in an option other than their own.

APPENDIX B

EXAMINATION REGULATIONS

3. Final examinations in all courses are University examinations.
4. Final examinations in all courses will form 70 per cent of the basis on which the degree is awarded, the other 30 per cent being coursework, including term assignments, tests and papers.
5. The grade obtained in all courses will be classified and published.
6. A candidate who fails in the equivalent of no more than two full courses in the University Examinations prescribed for any year may, on the recommendation of the Board of Examiners to the University Senate, be admitted to Supplementary Examinations within a period of four months after the end of the academic year. A candidate who passes his required Supplementary Examinations is deemed to have passed the University Examinations for the year.
7. A candidate who satisfies the Board of Examiners on either his University Examinations or his Supplementary Examinations may, on the recommendation of the Board of Examiners to the University Senate, be admitted to the following year and, in the case of candidates in the final year, be considered as a candidate for the award of the degree.
8. A candidate, in any year of the programme, who fails to satisfy the Board of Examiners on the equivalent of more than two full courses at the University Examinations may, on the recommendation of the Board of Examiners to the University Senate, normally be required:

   (a) On not more than one occasion, to repeat the year internally and resit the University Examinations at their next scheduled resiting provided that the candidate has not previously repeated the year internally.
   (b) To be discontinued from the University.
9. A candidate who fails to satisfy the Board of Examiners at the University Supplementary Examinations may, on the recommendation of the Board of Examiners to the University Senate, normally be required:-
   (a) On not more than one occasion, to repeat the year internally and resit the University Examinations at their next scheduled resitting provided that the candidate has not previously repeated the year internally.
   (b) To be discontinued from the University.
10. A final year candidate who passes the University Examinations prescribed for the end of the third year of study and who, in other respects qualifies for the award of the degree, shall be placed in one of the three classes to be described as First, Second (Upper Division or Lower Division) and pass. Honours shall be awarded to a candidate whose name is placed in the First Class or Second Class (Upper or Lower Division).
11. Candidate who write Supplementary Examinations in the third year shall not be eligible for the award of Honours.
12. A candidate who qualifies for the award of the degree only after repeating the entire University Examinations for either the second or third year of study shall not be eligible for the award of Honours in terms of Regulation 10.
13. The Bachelor of Commerce degree is classified on the basis of the percentage grades obtained by the candidates in all courses taken in Commerce grades obtained by the candidates in all courses taken in Commerce II and Commerce III of the programme. In the determination of the degree classification, the percentage grades obtained in the second year courses (Commerce II) will be given a weight of 0.5 and the percentage grades obtained in the third year courses (Commerce III) will be given a weight of 1.0.
14. The Bachelor of Commerce degree certificate is inscribed as either in "Accounting Option", "Business Administration Option" or "Insurance Option" depending upon the candidate's study programme.

Source: University of Nairobi Calendar, 1988/89, pp. 477 - 478.

APPENDIX C

MODEL VALIDATION

CLASSIFICATION OF INDIVIDUAL CASES

CASE	ACTUAL GROUP	PREDICTED GROUP	DISCRIMINANT SCORE
1	1	1	2.308
2	1	1	0.764
3	1	1	0.400
4	1	1	0.615
5	1	1	2.820
6	1	2	-0.804
7	1	1	0.338
8	1	1	0.545
9	1	2	-0.161
10	1	2	-0.158
11	1	1	2.306
12	1	2	-0.341
13	1	1	2.209
14	1	2	-0.712
15	1	1	1.629
16	1	1	2.891
17	1	1	0.499
18	1	1	1.253
19	1	1	0.986
20	1	1	0.227
21	1	1	0.561
22	1	2	-0.055
23	1	2	-0.067
24	1	1	1.872

CASE	ACTUAL GROUP	PREDICTED GROUP	DISCRIMINANT SCORE
25	1	1	1.002
26	1	1	0.733
27	1	1	2.255
28	1	1	1.679
29	1	2	-0.190
30	1	1	1.990
31	1	1	0.728
32	1	1	0.639
33	1	1	2.210
34	1	1	1.872
35	1	1	2.295
36	1	2	-0.068
37	1	1	1.225
38	1	2	-0.856
39	1	1	3.707
40	1	2	-0.137
41	1	1	0.375
42	1	1	3.055
43	1	1	2.176
44	1	1	0.836
45	1	1	0.834
46	1	1	0.773
47	1	1	1.313
48	1	1	2.040
49	1	1	2.567
50	1	1	1.980

CASE	ACTUAL GROUP	PREDICTED GROUP	DISCRIMINANT SCORE
51	1	2	-1.352
52	1	1	1.947
53	1	1	0.580
54	1	1	1.804
55	1	1	1.339
56	1	1	0.822
57	1	1	1.340
58	1	1	2.366
59	1	2	-0.104
60	1	2	-0.126
61	2	1	1.864
62	2	2	-0.815
63	2	1	0.147
64	2	2	-0.242
65	2	2	-1.662
66	2	2	-0.770
67	2	2	-1.531
68	2	2	-0.498
69	2	2	-0.235
70	2	2	-0.744
71	2	2	-2.959
72	2	2	-0.627
73	2	2	-0.681
74	2	2	-1.359
75	2	2	-2.696
76	2	2	-1.471
77	2	2	-0.792

CASE	ACTUAL GROUP	PREDICTED GROUP	DISCRIMINANT SCORE
78	2	2	-0.409
79	2	2	-0.548
80	2	2	-1.677
81	2	2	-2.903
82	2	2	-0.650
83	2	2	-2.197
84	2	2	-0.792
85	2	2	-1.736
86	2	2	-0.874
87	2	2	-1.278
88	2	1	0.347
89	2	2	-1.229
90	2	2	-1.557
91	2	2	-0.905
92	2	1	0.658
93	2	2	-0.944
94	2	2	-1.937
95	2	2	-1.814
96	2	2	-0.195
97	2	2	-1.805
98	2	2	-2.399
99	2	1	1.717
100	2	2	-0.670
101	2	2	-0.103
102	2	2	-2.316
103	2	2	-2.586
104	2	2	-1.028

CASE	ACTUAL GROUP	PREDICTED GROUP	DISCRIMINANT SCORE
105	2	2	-1.918
106	2	1	1.618
107	2	2	-0.977
108	2	1	0.513
109	2	1	0.272
110	2	2	-0.740
111	2	2	-2.236
112	2	2	-1.313
113	2	1	0.529
114	2	2	-2.293
115	2	2	-0.004
116	2	2	-1.016
117	2	2	-0.963
118	2	2	-3.178
119	2	2	-2.055
120	2	2	-0.871

CORRECT CLASSIFICATION RATE = 80.8%

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