A COMPARISON OF S.C.E. AND G.C.E. SCHOOL QUALIFICATIONS AS PREDICTORS OF UNIVERSITY PERFORMANCE

Ian David Diamond

A Thesis Submitted for the Degree of PhD
at the
University of St Andrews

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ABSTRACT

The University of St. Andrews is unique in that one half of its intake has Scottish Certificate of Education (S.C.E.) qualifications and the other General Certificate of Education (G.C.E.) qualifications. Also, the S.C.E. qualified students have consistently been more likely to fail than have their G.C.E. qualified counterparts. The aim of this thesis is to develop a scale to compare S.C.E. and G.C.E. qualifications and to investigate some of the causes for the differential performance.

The first part of the thesis considers whether the level of failure at St. Andrews is higher than that at other universities and then reviews the varied literature on academic performance to assess the potential relevance of a number of variables as predictors of performance.

It has been common in educational research to adopt linear weightings for S.C.E. and G.C.E. grades in statistical analyses. The next section investigates the linear weights and finds that, at St. Andrews, they may be improved upon. An alternative scoring system is developed and a model to estimate an entrant's probability of failure constructed.

Thirdly some qualitative reasons for the differential in performance are examined through two surveys: one of the academic and social experiences of the students' first year, and the other of the reasons given by students for choosing an ordinary degree.

Finally, some suggestions are made regarding possible improvements in procedures for monitoring student progress and of the potential for improving the assistance offered to new students to help them to complete successfully a degree course.

TO: J.L.D.
S.B.D.
H.F.D.

DECLARATION

I hereby declare that the following thesis is a record of research work carried out by me, that the thesis is my own composition and has not been previously presented in application for a higher degree.

IAN DAVID DIAMOND

POST GRADUATE CAREER

I was admitted into the University of St. Andrews as a Research Student under Ordinance General No. 12 in October 1976 to work on "A Comparison of S.C.E. and G.C.E. School Qualifications as Predictors of University Performance" under the supervision of Professor R. M. Cormack. I was admitted under the above resolution as a candidate for the Degree of Ph.D in October 1977.

CERTIFICATE

I certify that Ian David Diamond has satisfied the conditions of the Ordinances and Regulations and is thus qualified to submit the accompanying application for the Degree of Doctor of Philosophy.

Professor R. M. Cormack

Acknowledgements

I would like initially to thank my supervisor, Professor Richard Cormack, for his constant help and encouragement throughout the period of this research.

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CONTENTS

CHAPTER 1

INTRODUCTION

In November 1972 a working party of the Senate of the University of St Andrews reported that:

"Academic failure will always occur but we have enough evidence to show that the pattern of failure, especially in the first year, is somewhat surprising. A high proportion of those whose studies were discontinued in 1972 had above average grades in their entrance qualifications. A disproportionately high percentage were students with Scottish entrance qualifications. The pattern of ultimate success, as measured in the results in the Honours examinations, does not seem to be in any way related to this pattern of first year failure".

At the end of the next academic year, in September 1974, in the Science faculty 23.6 per cent of those Scottish qualified students who had just completed their first year had their studies officially discontinued as opposed to only 1.6 per cent of their contemporaries who had GCE school qualifications. Similar discrepancies were observed in the Arts faculty, but here the proportions being discontinued were much smaller. These figures were publicised nationally and resulted in an acrimonious debate with claims that Scottish students were being discriminated against in one of their own universities being countered by others that Scottish students were the authors of their own misfortune through not working hard enough. Many of the arguments offered by both sides of this debate could not be justified on a sound scientific basis, and in this thesis we will attempt to compare the performance of SCE and GCE qualified students at St Andrews University in a scientific manner. Initially, let us describe the educational setting within which this study will take place.

1.1 ENTRANTS TO THE UNIVERSITY OF ST ANDREWS

Of the entrants to St Andrews, approximately 50 per cent have sat the Scottish Certificate of Education examinations (SCEs); a similar percentage enter with qualifications from one of the examining boards of the General Certificate of Education (GCE). The figures for the years 1973 to 1977 are displayed in Table 1.1 . This situation is unique in the United Kingdom. Of the other Scottish universities, Edinburgh, Aberdeen and Dundee have the largest proportion of GCE qualified students, but in no case other than St Andrews are the proportions of entrants from the two backgrounds equal.

The observation that SCE students are more likely to fail their first year courses than their GCE contemporaries has been replicated at the three universities mentioned above and at Stirling University. The Edinburgh figures are the most fully reported [Academic Performance 1972-75] and we will discuss their findings in detail in Chapter 2. Analogous situations have also been observed in parts of Southern Africa, notably Botswana (Waterston 1979) and South Africa. In the latter case, students from Zimbabwe tended to perform better than their locally qualified counterparts.

There are a number of reasons why, a priori, it is not surprising that GCE students are less likely to fail their first year. To clarify these let us compare the structure of secondary education in Scotland with that of the rest of the United Kingdom.

There are four main differences. Firstly, Scottish secondary education is shorter in duration than that of the rest of the

Year	Arts		Science	
	SCE	GCE	SCE	GCE
1973/74	231	158	199	122
1974/75	203	158	183	112
1975/76	186	174	141	119
1976/77	144	199	147	126
1977/78	158	226	146	139

Table 1:1: Entrants to St Andrews by type of school qualification 1973-1977

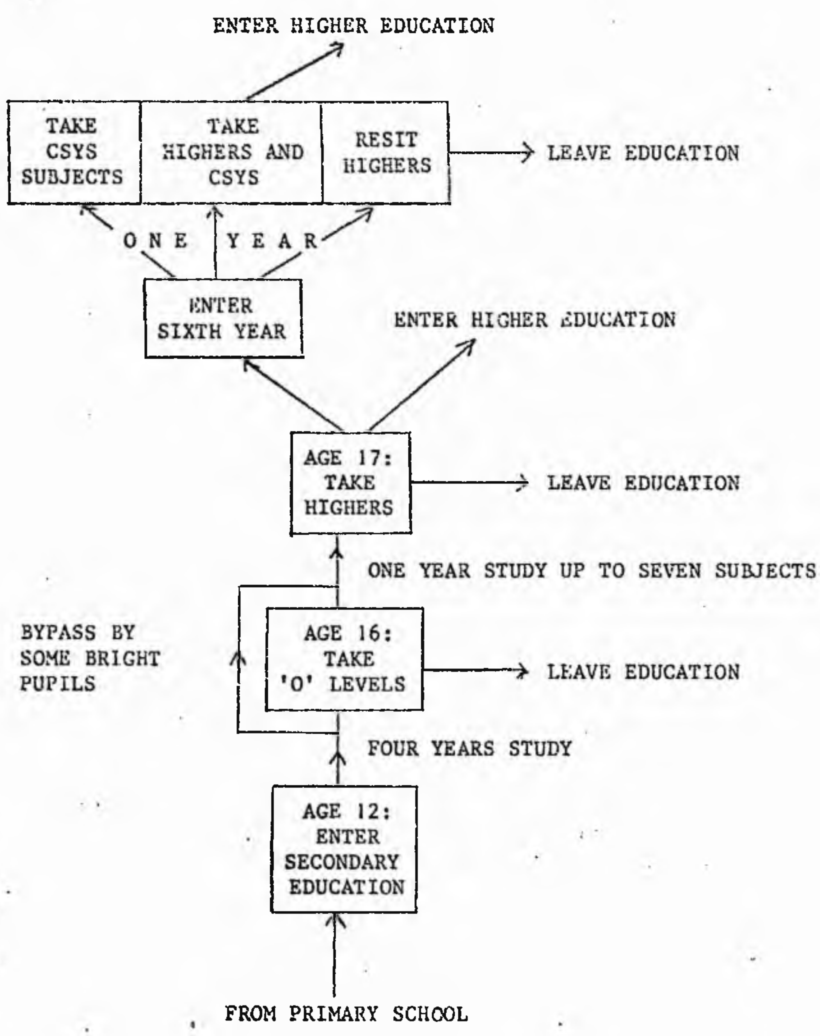

Figure 1:1: Flow diagram of SCE based secondary education

United Kingdom. Scottish students enter secondary education at 12 years of age and may attain sufficient academic qualifications to transfer to higher education after five years of secondary education, ie at age 17. For many years a large majority of SCE students did enter higher education at this time. More recently, however, it has become common for students to stay at school for an extra year prior to undertaking a course of higher education. We will discuss the structure of the sixth year below. In the rest of the United Kingdom students enter secondary education at eleven years of age, and do not, in general, attain sufficient academic qualifications to enter university until they are 18 or 19, ie after seven or eight years of secondary education.

Secondly, the philosophies underlying the two systems have resulted in there being a distinct difference in the structure of the syllabuses in the two systems. In Scotland, the ideals of a broad based secondary education have meant that those students intending to continue to higher education take five or more Highers in their fifth year, following one year of post-compulsory study. Most of those students will take English and Mathematics with half taking at least one more Science and one more Arts subject, the rest taken from an extensive range. Those students in the GCE system, on the other hand, spend two years of post-compulsory education concentrating on three or, unusually, four subjects. These subjects are, in most cases, taken from cognate disciplines, although recently there has been more diversity.

The third difference concerns the experience of those SCE students who enter higher education. Until the late 1950's the sixth year was taken primarily by those attempting the universities bursary examinations and by others who were required to upgrade their Highers grades to enter higher education. There was felt to be a need for reform and, following two Advisory Councils, a Scottish Education

Department report (SED 1966) set out the official aims for a new "Certificate of Sixth Year Studies" (CSYS). This certificate was intended to be supplementary to the Higher examination, and was to be aimed at a wide range of ability and was not intended to be used as a prerequisite for entrance to higher education. Students were to be allowed to take up to three CSYS courses, in subjects they had already passed at Higher. CSYS courses are now offered in 20 subjects, and are taken by a majority of university entrants at St.Andrews.However,not all have either stayed at school for a sixth year or, if they have, taken solely CSYS courses in this year. Scottish entrants to university have, in general, experienced one of four types of pedagogy in their last year at school: Highers taken in fifth year; Highers taken in sixth year; a combination of Highers and CSYS subjects; CSYS subjects alone. For GCE entrants, on the other hand, the final years of school study are likely to have been fairly uniform.

Fourthly, we will observe in Chapter 2 that a higher proportion of students from Scottish schools commence a course of higher education than do students from schools in other parts of the United Kingdom.

Figures 1.1 and 1.2 show flow diagrams of the two systems to help clarify these differences in the secondary education.

1.2 THE UNIVERSITY OF ST ANDREWS

The differences in secondary education described above have led in turn to differences in the structure of university education between Scotland and the rest of the United Kingdom. In Scotland the ideals of a broad education have been carried through to university.

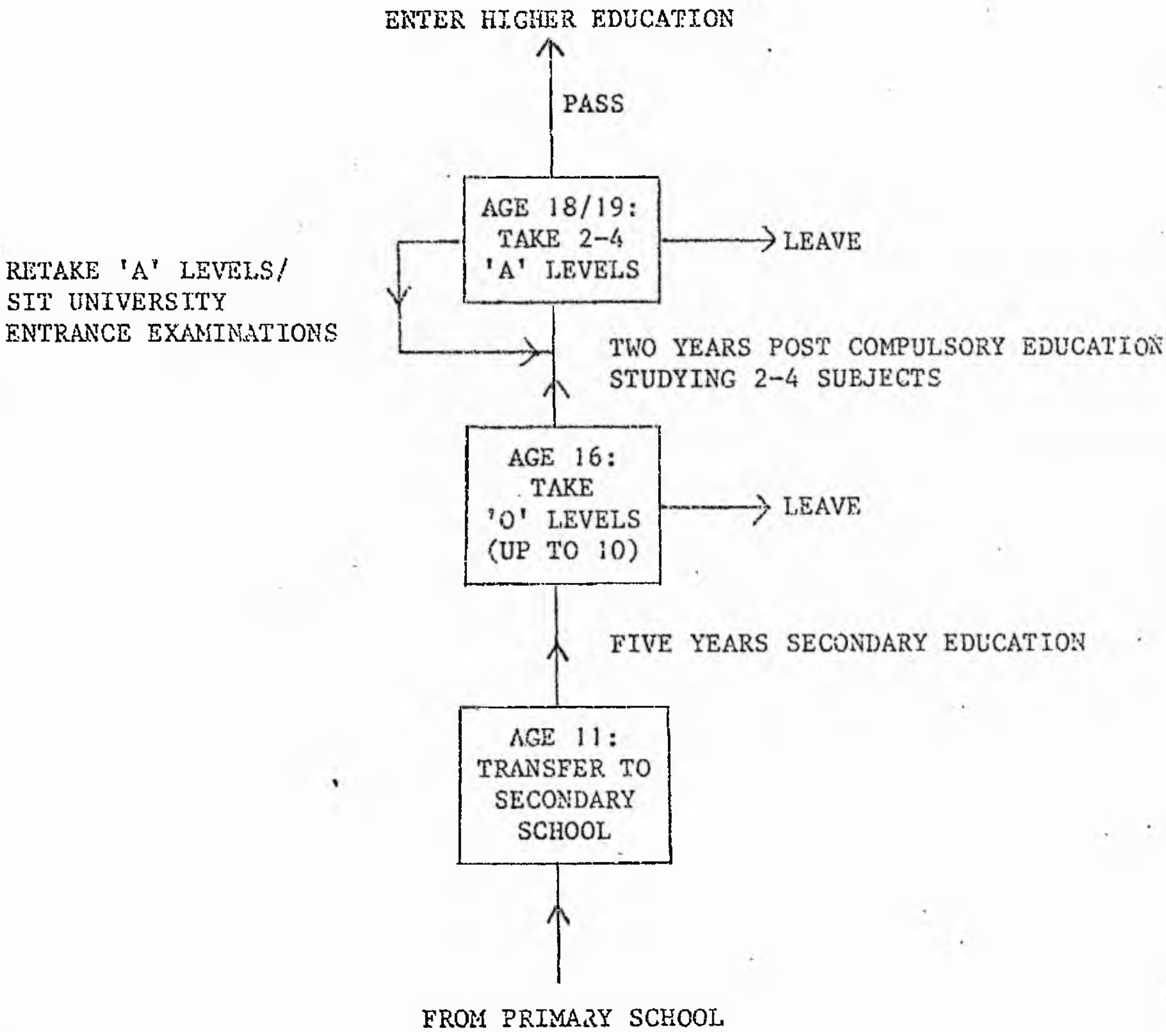

Figure 1:2: Flow diagram of GCE based secondary education

An Honours degree in a Scottish university takes four years as opposed to the three usual elsewhere in the United Kingdom. The first year of this course is, commonly, a general year in which the student takes a number of subjects. Although it is usual for students to specify an intended degree on entry to university, it is easier for students to alter this intended degree after their first or, to a large extent, second year at university than would be true in a university elsewhere in the United Kingdom. Furthermore, a traditional route in Scottish education has been for students to elect to take an Ordinary degree, while in England such a degree is generally awarded by default. This degree may take three or four years and comprises a variety of courses which the student takes to a level below that of Honours. The Ordinary has traditionally been taken prior to a period of professional or teacher training. In recent years, this route has become less common. We will discuss it fully in Chapter 7.

Let us now consider the entrants to St Andrews. Students are admitted on the basis of either their four best Highers, or their two or three best 'A' levels to one of four faculties: Arts, Science, Divinity and Medicine.[1] The Faculty of Medicine is a special case for three reasons. Firstly, the competition for places in medical schools means that those who are admitted tend, as a group, to have performed better at school than their contemporaries who enter the Faculty of Science. Secondly, all entrants intending to take Medicine register for an Ordinary degree, which they take in three years. Following this most transfer to the University of Manchester for clinical training, although some students do stay at St Andrews for one extra year when they take a degree in, say, Biochemistry or Physiology. Thirdly, the discontinuation rate in this faculty is extremely low. For these reasons, students in the Faculty of Medicine are excluded from most of

1.There is no Faculty of Medicine,but for admission and graduation purposes the Medical course is essentially a Faculty of Medicine and we shall treat it as such in this thesis.

the analyses in the following chapters.

There are very few entrants to the Faculty of Divinity. Two options were therefore open. Firstly, we could amalgamate students of Divinity with those of Arts or, secondly, we could exclude the Divinity Faculty from the analyses. As there are very few GCE qualified entrants to the Faculty of Divinity and as our main interest is in a comparison of SCE and GCE qualified students, the latter course was chosen.

To consider the possible routes which a student may take to a degree at St Andrews, Figure 1.3 shows a flow diagram which illustrates these routes. In their first year each student takes three subjects. Good performance during the year may lead to the student being exempted from the end of year (or degree) examination. Those students who have not passed a particular subject by June may sit a further examination in September. In order to qualify for entry to second year, a student must pass at least two subjects. Those students who fail to pass two subjects may appeal to the Senate for leave to continue with their studies. The Student Academic Performance Committee (SAPC 1975) recommended that this qualification should be reduced to one subject for SCE qualified entrants to the Faculty of Science, but this was rejected by the Senate who did, however, agree that "the utmost leniency, however, would be shown to students who, because of the inadequate preparation afforded by their schooling, had achieved a pass in only one 1st BSc subject". Those students whose appeal is rejected have their studies officially discontinued.

In their second year students study two subjects at "2nd BSc" or "Special" level. These are either subjects taken in first year or are new, eg Biochemistry, but may presuppose certain first year passes. Students in the Arts faculty must also take one further first year subject. For those students who wish to undertake an Honours degree

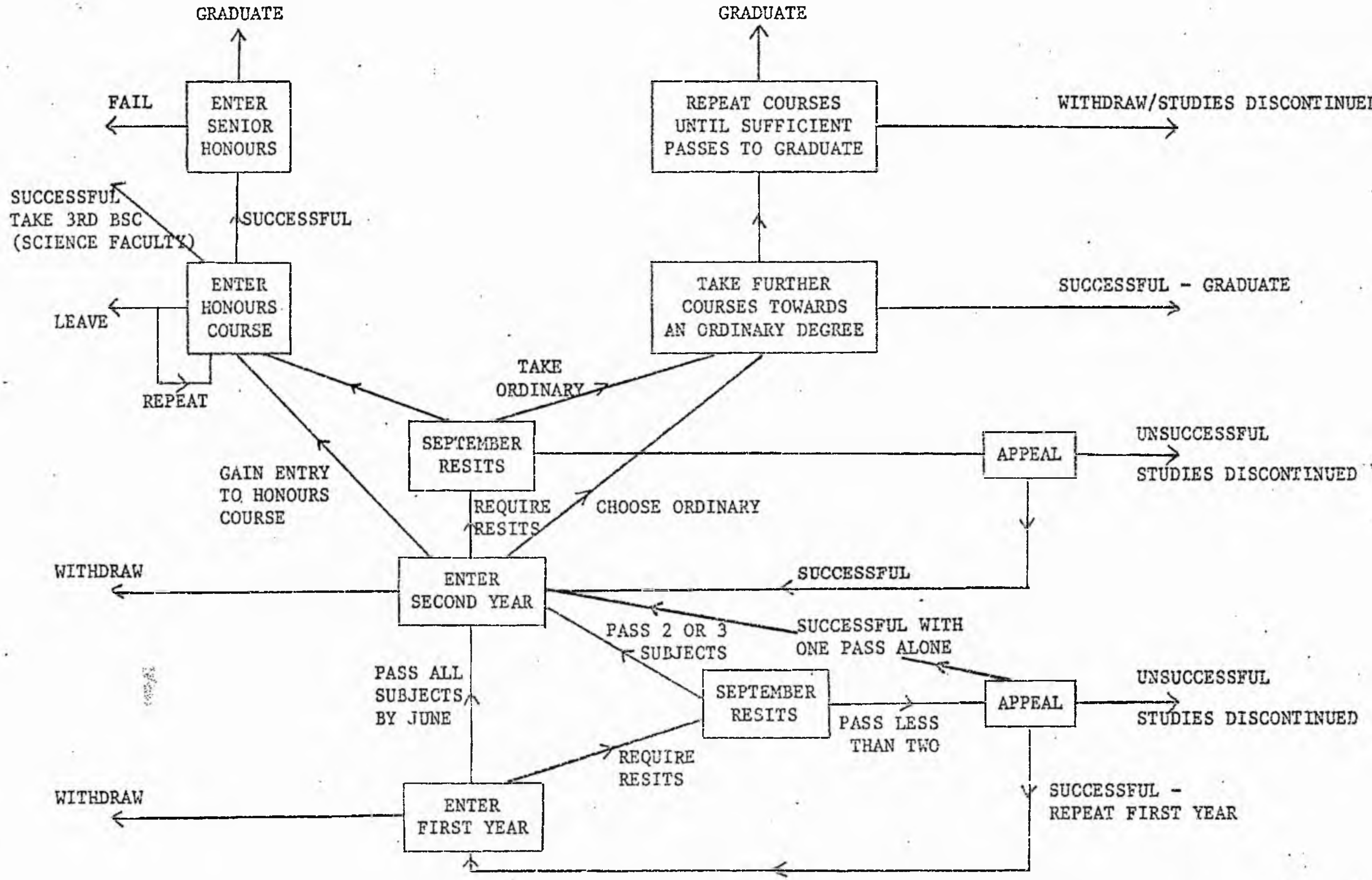

Figure 1:3: Flow diagram of paths to a degree at St Andrews

course, entry is decided on their performance in their second year subjects. Those accepted onto an Honours course spend two years (called Junior and Senior Honours) in concentrated study of this subject or jointly in study of two subjects. After a successful Junior Honours year in the Science faculty a student may elect to accept a 3rd B.Sc. and leave with an Ordinary degree.

Those students who elect not to take an Honours degree, or are not accepted, take an Ordinary degree. To be permitted to return for a third year without appeal, Arts students must have passed at least four courses and Science students three. To be awarded an Ordinary degree an Arts student must have passed eight courses, at least two at second year level and a Science student seven, again with at least two at second year level. The normal length of time for an Ordinary degree is three years but an Arts student with five passes at the end of their second year, or a Science student with at least four, is permitted to return for a fourth year to complete the requirements.

In practice, there are many more routes by which a student may proceed to a degree, but most of them are fairly circuitous, and often mean that a student has been required to repeat a year. These will not be discussed here.

1.3 AN OVERVIEW OF THE THESIS

In the last two sections we have described the environment within which this study has taken place. Let us now turn to the problems to be investigated in the thesis.

There are five main sections in the thesis. The first consists of Chapters 2 and 3 which review the literature associated with studies which attempt to predict academic performance. Chapter 2 considers the independent variables which have been used to predict academic performance and discusses their relevance for a study at a Scottish university, while Chapter 3 consists of a review of the statistical techniques used in such studies and some of the drawbacks associated with their use.

The second section of the thesis consists of Chapter 4 and investigates one of the drawbacks described in Chapter 3. In this chapter we describe some methods which try to assign ordinal scores to school grades and university degree classifications so as to optimise the prediction of university performance on the basis of school qualifications. An adaptation of methods described by Sibson (1971) and Gordon (1973) is used to assign weights to GCE 'A' level and SCE Higher grades which permits the direct comparison of the grades as predictors of university performance.

In Chapter 5 we compare the scale devised in Chapter 4 with other possible scales, as predictors of failure in the university. Next we consider the prediction of failure in different groups of students divided by their sex, their faculty of entry and their type of school qualification. Finally, we consider the prediction of final performance by school, first and second year performance both for the group as a whole, and for different subjects separately.

The next section of the thesis, Chapter 6, reports the results of a survey of the attitudes and experiences of a large sample of the students who entered St Andrews in October 1976. The discussion compares the problems encountered by SCE and GCE students and it suggests how poorly qualified students may be helped to complete their first year successfully.

Chapter 7 investigates the reasons given by students taking an Ordinary for their choice of degree, and finally Chapter 8 concludes the thesis by making some recommendations concerned with minimising the number of students whose studies need to be discontinued.

CHAPTER 2

SUCCESS AND FAILURE AT UNIVERSITY

There is a wide, varied and interesting literature on the subject of academic performance. The literature includes studies which investigate methods of measuring and predicting performance, some of which attempt to identify the causes of good and bad performance and others which investigate the characteristics of "over" and "under" achievers. Much of the research has been carried out in the United States, but there is also a considerable volume of work from Britain as well as valuable contributions from numerous other countries.

Studies of academic performance have been undertaken by a variety of practitioners, eg sociologists, psychiatrists, administrators and with a number of aims. It is important, therefore, to identify those characteristics which relate most closely to the present study. While there are already a number of good reviews of the literature[1], the purpose of this review is to establish the terms of reference for the study at St Andrews, to investigate the efficiency of various predictors of academic performance and to consider their relevance to a study of performance in a Scottish university. The first section considers the problem of defining failure and of whether there is an abnormal failure rate in Scottish universities in general and St Andrews in particular. The second will examine some of the reasons and justifications for undertaking studies of academic performance. The main section of the review will then describe those variables which

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1 Miller (1970a), Wilson (1969), Watts (1972) and Entwistle and Wilson (1977) describe the British work. Astin (1975), Cope and Hannah (1976), Iffert (1958), Lavin (1965), Marsh (1966), Panatages and Creedon (1978), Spady (1970) and Summerskill (1962) cover, between them, most of the American research, while Sanders (1961), Miller (1970b) and Ingenkamp (1977) describe work elsewhere.

have been used previously in studies of academic performance. It will focus most attention on the potential of school academic qualifications as predictors of university performance and will also consider the relevance and practical use of other variables commonly associated with performance at university.

2.1 LEVELS OF FAILURE

In this section we will investigate the extent to which failure rates in Scotland as a whole, and St Andrews in particular, differ from those elsewhere. If we consider simply the percentage of entrants to university who do not complete a degree then Scottish failure rates appear to be fairly low. However, a closer examination reveals that in many studies the definitions of failure used are very ambiguous and by making a careful definition of failure we will see that Scottish failure rates are not markedly different from those in many other countries.

There is some difficulty in investigating the true level of failure in higher education. Throughout the literature few of the studies report failure rates. There are two main reasons for this. Firstly many studies use self-selected samples of students. Even when the sample size is large, it is those students who perform worst who tend not to offer themselves for study, eg Entwistle and Wilson (1977). Secondly, many universities are, for political reasons, very wary of releasing any details on the numbers of their students who fail, while others keep only sparse records. For example, the failure rate at St Andrews was not calculated systematically until 1975 (St Andrews SAPC (1975)). In America, Panatages and Creedon (1978) report that it is only recently that most colleges have kept accurate records of the numbers who leave at the end of each semester, whether for academic or other reasons.

In those studies that do report accurate failure rates, there is often a further problem. Many studies define failure as not completing the degree for which the student registered in the institution in which he or she first registered. This is a very crude definition of failure as it includes three groups: those who did not obtain a degree because of academic failure, either during the course or in the final degree examination - we shall call these failures; those who drop out from their course for some non-academic reason, eg illness, marriage, whom we shall call drop-outs; and those who leave their institution to transfer to another institution and another course - we shall call this last group transfers. There are also students who will withdraw because they feel they have little chance of success in the examinations. It is important to understand fully a student's reasons for withdrawal. Unless allowance is made for these groups in an analysis, the observed failure rate will be an inflated figure. It will, for example, be very dependent on the society in which the student is living, and its attitudes to entering and leaving higher education. For example, let us consider Table 2:1. This shows the percentage of the relevant age group who entered either university or any form of higher education in a variety of countries in 1965. In those countries where a wider range of ability enter university, there must either be lower standards in some institutions, a higher level of failure, or much better methods of teaching. Astin (1975) demonstrates the first of these consequences in the USA, while the second is manifested in countries such as the United States or the Philippines where it is an accepted practice to enter and leave more than one institution in the course of gaining a degree.

The importance of considering the percentage of the age group who enter university is well summed up by the Robbins report (1963)

Table 2:1: Percentage of relevant age groups entering higher education in 1965 classified by sex OECD (1971)

	Universities		All Higher Education	
	Female	Male	Female	Male
United States	24.9	31.2	33.5	44.0
France	11.0	12.2	-	-
Sweden	10.6	14.3	14.3	16.0
Italy	10.5	18.1	11.0	18.5
Finland	10.2	10.0	-	-
Greece	7.3	11.5	8.3	12.5
Denmark	6.4	13.7	12.0	18.8
Belgium	5.9	13.3	17.7	25.7
Ireland	5.2	11.7	-	-
Scotland	5.1	11.0	17.9	15.8
Austria	5.0	11.3	5.0	11.3
Japan	4.6	21.8	11.6	23.6
Norway	4.6	11.1	-	-
England and Wales	3.8	8.6	11.7	16.7
United Kingdom	3.7	8.8	10.6	14.8
West Germany	3.0	9.3	5.9	17.1
Holland	2.1	8.5	7.1	18.2
Turkey	1.3	3.8	1.9	7.1

Note: The figures for Scotland and for England and Wales are, in fact, estimates. They were calculated from the figures given in the Robbins report (1963). These figures were multiplied by the proportional increase for the U.K. as a whole given above.

which, while accepting that Britain has comparatively low failure rates, says that in a system which is so highly selective, the 14 per cent overall failure rate they had observed hardly merited congratulation.

2.1.1 Scotland

Let us start by considering research which reports failure rates in Scotland. The first important study was conducted by the Scottish Council for Research in Education (SCRE 1936) which investigated the final degree performance of all entrants to Scottish universities in 1928. They showed that 7.8 per cent of all entrants had had their studies officially discontinued. This figure was inflated to 16.5 per cent when they considered those students who, for some other reason, had not completed their degree by 1932.

In the 1950's, Craig and Duff (1961) studied Pure Science students at Edinburgh University and reported failure rates between 10 and 21 per cent for the years 1954 to 1959 (mean = 15.6 per cent) and overall non-completion rates between 10 and 26 per cent. Table 2:2 is taken from the Universities Grants Committee report (1968) and displays the failure rates for the cohort of students who would normally have graduated from a mainland British university in the academic year 1965/66. It should be noted that some of these failure rates are misleading. A number of new universities were created in the mid 1960's, eg Heriot-Watt College of Technology became the Heriot-Watt University. Therefore, the figures for such institutions will refer to their failure rates before they became universities. Furthermore, some of the newer universities tend to specialise in technological subjects which, as we shall see, have different failure rates from Arts and Social Science subjects. Therefore we will concentrate our attention on the

	PERCENTAGE LEAVING WITHOUT A DEGREE		NO. WHO WOULD NORMALLY HAVE EXPECTED TO GRADUATE
	ACADEMIC FAILURE	NON-ACADEMIC REASON	
BIRMINGHAM	7.0	2.7	1255
BRISTOL	7.4	2.3	1110
CAMBRIDGE	2.1	1.3	2263
DURHAM	4.5	1.6	550
LEEDS	8.7	3.0	1509
LONDON	10.3	3.7	5048
LOUGHBOROUGH	29.2	4.8	493
MANCHESTER	6.9	2.9	1500
OXFORD	3.2	1.9	2298
TOTAL ENGLAND	9.7	2.5	27479
ABERDEEN	13.1	2.8	720
DUNDEE	8.5	2.7	442
EDINBURGH	13.3	2.9	1553
GLASGOW	15.3	3.0	1423
HERIOT-WATT	32.9	0.8	238
ST. ANDREWS	12.8	1.6	368
STRATHCLYDE	28.9	0.8	656
ALL SCOTLAND	16.1	2.4	5400
ALL G. B.	10.9	2.4	35386

TABLE 2:2 PERCENTAGE LEAVING WITHOUT A DEGREE OF THOSE WHO WOULD NORMALLY HAVE EXPECTED TO GRADUATE IN 1965/66 FOR A SELECTION OF ENGLISH UNIVERSITIES AND ALL SCOTTISH UNIVERSITIES.

SOURCE: U.G.C. 1968.

four older Scottish universities together with Dundee, which had previously been a college of St Andrews. We see that the failure rates range from 11.2% to 18.3%, figures very similar to those from earlier years.

Figures for more recent years are shown in Table 2:3. The sources are St Andrews (SAPC (1975)) and Aberdeen (Nisbet and Welsh (1976)). It may be seen that the levels of failure have remained fairly constant at Aberdeen while at St. Andrews there has been no obvious trend.

2.1.2 England

Data for English universities are even harder to find. Newfield (1963) describes a national survey of the academic careers of the cohort of 1955 entrants to every United Kingdom university except Aberdeen. He reports a failure of 3 per cent for his sample, but concedes that the response rate for failures was much less than for successes. Kelsall (1963) describes a group of studies in six universities which show failure rates between 12 and 25 per cent [Kelsall mentions that some of these studies refer only to certain faculties]. Table 2:2 displays the Universities Grants Committee data (1968) showing that there are large inter-university differences ranging from Cambridge with a failure rate of 3.4 per cent to Loughborough with 34 per cent. Here again, some of the higher figures are inflated, all of the failure rates above 20 per cent occurring in new universities. The remaining failure rates for England and Wales are a little lower than those for similarly sized Scottish universities. However, reference to Table 2:1 shows that the percentage of the age group who enter university in Scotland is higher than that for the rest of the United Kingdom. Many studies (eg Nisbet and Welsh (1966), Wilson (1969), Jones et al (1973)) have found that it is the poorer qualified SCE students who are most at risk of failure. It is perhaps possible that these poorer qualified students would not, in

Table 2:3: Discontinuation rates at the Universities of St Andrews and Aberdeen (figures are percentages)

ST ANDREWS

	1966/67		1967/68		1973/74		1976/77	
	Science		Science		Science		Science	
	Scot	Eng	Scot	Eng	Scot	Eng	Scot	Eng
Discontinuation rates	18	8	10	9	24	2	15	2
					Arts		Arts	
					Scot	Eng	Scot	Eng
					5.5	0	1.4	0

ABERDEEN

All entrants

	1966/67		1967/68		1968/69		1969/70		1970/71	
	Scot	Eng	Scot	Eng	Scot	Eng	Scot	Eng	Scot	Eng
Discontinuation rates	19	6	17	7	19	6	21	8	22	2

England or Wales, have been admitted to a university course.

During the 1970's many performance studies have been published but they rarely quote failure rates. Exceptions include Whitehead (1974) who reports failure rates at Birmingham University Dental School between 1963 and 1969 finding an average of 11.4 per cent and Abercrombie et al (1969) who study an architecture school in London and report a failure rate of 22 per cent.

Let us consider inter-subject comparisons. Table 2:4 displays both the failure rates and also the combined drop-out and transfer rates for the UGC report (1968). In Table 2:4, the highest failure rates occur among Architecture students (23.7 per cent) and the lowest among Arts students (6.3 per cent). They demonstrate that the higher failure rates occur in the more technical and scientific subjects where performance tends to be more dispersed. Smithers and Dann (1974) report a study of 459 students of Engineering, Physical Sciences and Languages at the University of Bradford. They found failure rates of 25 per cent for Engineering, 20 per cent for Languages and 19 per cent for Physical Science. All of these subjects, at Bradford, are assessed fairly objectively and this similarity is reflected by the high similar failure rates.

Finally we consider the relative proportions who leave for academic and non-academic reasons. The UGC report states that in England, 79.6 per cent of those who failed to complete a degree did so because of academic failure while the comparative figures for Scotland and Wales are 86.7 per cent and 89.9 per cent respectively. An explanation for the difference between English and Scottish universities is perhaps that the Scottish system allows movement between subjects more easily than is possible at many English universities. Kendall (1964a) reported that 70 per cent of those who left University College London completed a degree elsewhere. Therefore English students may be more

	PERCENTAGE LEAVING WITHOUT DEGREE		NO. WHO WOULD NORMALLY HAVE GRADUATED IN 1965/6
	ACADEMIC FAILURE	NON-ACADEMIC REASON	
ARTS	6.2	3.2	8988
SOCIAL SCIENCE	6.5	2.6	5819
BUSINESS STUDIES	6.6	2.2	45
PHYSICAL SCIENCES	12.8	1.8	5336
MATHEMATICS	11.5	2.1	2273
BIOLOGICAL SCIENCES	10.5	1.6	2197
ENGINEERING	20.1	1.8	6001
OTHER TECHNOLOGY	17.5	2.5	400
MEDICINE	5.9	2.9	2060
DENTISTRY	9.2	2.8	568
AGRICULTURE	15.3	2.0	542
VETERINARY SCIENCE	9.2	3.0	228
ARCHITECTURE	23.7	2.9	245
TOWN PLANNING	0.0	9.5	42

TABLE 2:4 PERCENTAGE LEAVING WITHOUT A DEGREE OF THOSE WHO WOULD NORMALLY HAVE EXPECTED TO GRADUATE IN 1965/66.

SOURCE U.G.C. (1968)

likely to admit to having made a mistake with a particular university or course and leave before being required to as a result of academic failure.

2.1.3 USA

There are a large number of American studies of performance, many of which investigate the reasons behind a student failing to complete a degree. In American studies it is important to remember the fundamental difference between dropping out and failing. For example, Summerskill (1962), describing 35 studies of academic performance, says that, on average, 40 per cent of entrants pass in the minimum time (four years) while a further 10 per cent graduate in later years. Of the remaining 50 per cent, 40 per cent re-enrol on another course, perhaps at a different institution and of these half graduate. Therefore, the combined failure and drop-out rate is 30 per cent. This is still higher than the United Kingdom but as this is a combined rate we need to consider the taxonomy of failure suggested above. Similar taxonomies have been suggested by some American studies, eg Johansson and Rossman (1973), Astin (1975). Knoell (1966) suggested that it was better to use a simple dichotomous criterion of success and failure and this has been supported recently by Panatages and Creedon (1978) who argue that it is a false implication to regard a voluntary drop-out as any more determined by social forces than a failure. Furthermore they argue that to label leavers as "non-voluntary" obscures the crucial issue of why well qualified students get poor grades in the first place.

A criticism of the first argument is that a voluntary drop-out wants to leave the institution as a result of certain social forces that have acted on him or her. A "failure" is likely to want to stay and continue studying but has had his or her studies discontinued by the institution. There have been articles, eg Williams (1974), Pervin et al (1966), which argue that students may make a conscious decision to fail because they dislike their parents or, alternatively, because they perceive that their parents would not be happy if their children achieved higher educational goals than they themselves had but, generally, the evidence does not support a view that such students form a high percentage of the total drop-outs. To answer the second argument, by forming a taxonomy of the types of "failure" we are attempting to identify the "under-achievers" from those whose decision to leave is their own. To resist forming such a taxonomy is to invite confusion.

However, as long as we are sure of the definition of failure in use there is much to be gained from studying the American literature. Table 2:5 presents a summary of the levels of failure in a selection of American studies. There is some disagreement between the studies. Much of this disagreement may be explained by considering the type of college under study. Astin (1971) discussed the differences in the academic abilities of the students in different institutions as measured by their performance in an entrance aptitude test. On this basis he divided the tertiary institutions into seven "selectivity" levels. Astin found that in institutions at the upper end of the scale dropping out is far less common. Robbins (1963) agrees when he reports that academic failure in a prestigious university such as Stanford may be as low as 2 per cent. Trent and Medsker (1967) found higher failure rates than, say, Bayer (1968) or Panos and Astin (1968) but studied less selective colleges. Table 2:6 shows the drop-out rates for Astin's seven levels of selectivity for his sample of 101,000 students. We see that at the upper three levels, which correspond most closely to the percentage of the age group entering university in Scotland, the

Table 2:5: Some failure rates from American studies

Study	Date	Sample	Results
1. McNeely	1938		40% graduate in minimum time
2. Iffert	1958	12,667 from 149 institutions	40% graduate in minimum time, 60% graduate at some time
3. Bayer et al	1973		40% never graduate
4. Trent and Medsker	1968	10,000	36% graduate in minimum time from universities 30% still registered
5. Panos and Astin	1968	127,212 from 248 institutions	50%-60% graduate after four years
6. Bayer	1968	100,000	60.5% graduated within five years 17.9% still enrolled
7. Sewell and Shah	1967	One third of Wisconsin High School graduates	48% graduate in seven years
8. Robinson	1967	University of Illinois entrants 1962	50% graduate in four years

Table 2:6: Failure by selectivity level of college as defined by Astin (1971)

Institutional selectivity level	Mean SAT score	Percentage of students from entering population enrolled in each level		Actual drop-out rate	
		Male	Female	Male	Female
7	> 1235	4	3	12	10
6	1154 - 1235	10	8	23	17
5	1075 - 1153	12	15	27	17
4	998 - 1074	20	28	29	24
3	926 - 997	17	19	36	35
2	855 - 925	8	8	49	40
1	< 855	7	6	49	42
ungraded		22	14	54	52

N.B. Due to rounding the Female percentages of the entering population in the various selectivity levels add to 101.

Table 2:8: Mean cumulative percentage of drop-outs after eight semesters at college

Source: Panos and Astin (1968)

Semester	Percentage
1	8.6
2	22.0
3	28.5
4	33.2
5	43.1
6	44.5
7	48.0
8	50.0

drop-out rates vary from 10 to 27 per cent. Comparing these figures with those in Table 2:5 we see that the actual failure rates in America tend to be a little higher than those in the United Kingdom. The evidence from the literature would suggest that a large proportion of this American "failure" should more properly be defined as transfers and dropouts.

2.1.4 Failure Rates in Canada and Australasia

In Canada, Pike (1970) studied university participation and reported large inter-provincial differences. Fleming (1962) investigated the intake to Ontario universities and reports drop-out rates of around 20 per cent.

There have been a number of studies of failure in Australia and New Zealand. Miller (1970b) cites Hohne (1951), the Royal Commission on the University of Western Australia (1942) and the Murray Report on Australian Universities (1957) as making reference to overall failure rates of 30-40 per cent. The Murray Commission said that in 1957 in New South Wales only 4.4 per cent of the relevant age group entered university, while 16 per cent were qualified to do so; they expressed disquiet about such a large proportion of potential entrants being lost to the University sector.

Another problem in Australia is that a large number of well-qualified entrants are failing. Gray and Short (1961) reported that 25 per cent of scholarship holders failed to survive their first year.

Gani (1963) built a stochastic model of a student's probability of passing through to graduation using Gray and Short's data. He estimates the following probabilities: $p_{12}=0.61$; $p_{23}=0.71$; $p_3=0.81$; $p_{11}=0.15$ $p_{22}=0.11$; $p_{33}=0.10$, where p_{12} is the probability of passing successfully from year 1 into year 2, etc., and p_3 is the probability of passing third year. He therefore estimates that 35.08% will gain a pass degree in the minimum time of three years. Of these 20% take Honours, of whom 81% pass, and so Gani estimates that around 6% graduate with Honours in four years.

In New Zealand, Parkyn (1959, 1967) found that males passed 62 per cent of their first year courses while females passed 73 per cent.

In general, then, it appears that failure rates in Australia and New Zealand are higher than those in the UK.

2.1.5 General Considerations

There are two further considerations. Firstly a feature of the high failure rates in Australasia is that a large number of well-qualified students fail and poorly qualified students pass. This is a finding which has been duplicated in America by Astin (1973) and in Scotland by Nisbet and Welsh (1976). This is summed up by Schonell et al (1962) who say that the price of excluding about 30 students who would have failed to graduate (by raising admission standards) would have been the loss of 44 students who would have been successful in attaining their degrees. This would have increased the proportion of graduates from 68.5 per cent to only 71.8 per cent. At the same time they found that 40 per cent of the better qualified entrants did not graduate in the minimum time.

Secondly we consider at what stage most failure occurs. Table 2:7 comes from the UGC (1968) report and Table 2:8 is reproduced from Panos and Astin (1968) who report a national survey of failure in American universities. In the British study just under one half of the failures leave by the end of their first year of study. This percentage remains the same if we consider only those who fail for academic reasons. Furthermore there is little difference between Scotland and the rest of the United Kingdom. For St Andrews, 57 per cent of those who fail for academic reasons did so during their first year.

	FIRST TERM	REMAINDER OF FIRST YEAR	SECOND YEAR	OTHER	TOTAL	NO. WHO WOULD NORMALLY HAVE GRADUATED
ABERDEEN	0.0	8.8	3.6	3.8	16.2	691
DUNDEE	0.5	5.3	3.4	2.4	11.6	415
EDINBURGH	0.3	8.1	4.0	3.6	15.9	1462
GLASGOW	0.4	7.4	4.6	6.2	18.6	1383
ST. ANDREW'S	0.3	8.2	3.1	3.1	14.6	355
TOTAL SCOTLAND	0.4	9.0	5.0	4.5	18.9	5058
TOTAL ENGLAND	0.4	5.6	3.3	2.4	11.8	3086
TOTAL WALES	0.4	7.5	3.5	2.0	13.4	2400

TABLE 2:7 PROPORTIONS OF STUDENTS LEAVING WITHOUT A DEGREE BY TIME OF LEAVING FOR A SELECTION OF OLDER SCOTTISH UNIVERSITIES AND FOR THE U.K. AS A WHOLE.

SOURCE UGC (1968) p.82.

The American study also reports that around 50 per cent of those who leave do so by the end of their first academic year. These results indicate that research should consider the time of failure as it is perhaps advantageous to all concerned for those who are likely to be at risk of "failure" to find out as soon as possible.

2.1.6 Summary

In summary, we can say that the levels of failure in Scotland are marginally greater than those in England and Wales, but less than those in many other countries. Most of the failure is because of academic reasons. The proportion of "failures" who leave university for non-academic reasons tends to be lower in Scotland than in other countries.

2.2 WHY INVESTIGATE PERFORMANCE?

We have established that the failure rates in Scottish universities are comparable with those elsewhere in the world. However, to return to Robbins (1963), it is also true that they "hardly merit congratulation". We must now consider whether it may be profitable to endeavour to lower the failure rates, or whether we should assume that, under any conditions, a constant number of individuals will fail to adjust to a successful university career making a certain level of failure inevitable.

Most studies have assumed that it is possible to take steps to reduce failure. This has been borne out in practice [St Andrews SAPC (1975)], but we must ask whether taking such steps is justifiable.

There are two justifications: firstly, there are social reasons. If an individual has to leave university due to academic failure, it is likely to have a traumatic effect on that individual. He or she may feel "inferior" to those who pass, thereby having an effect on his or her confidence and general well-being. Secondly, and perhaps a major reason for much of the recent research, there is the economic effect on the university of losing students through failure. In 1963, Malleson (1963) calculated that one "student year" which ended in failure cost £700. This could be extrapolated to a 1963 figure of £5 million for the annual cost of failure in the United Kingdom. There are two ways of looking at this concept: one common (eg Blaug (1971)) way is to consider it as an economic cost to the state in terms of lost fees. Another way, which allows for the fact that not all fees are paid by the state, is to consider the loss in fees to the university. To explain, the university receives a certain amount of revenue in fees from each student. The marginal cost of teaching one student for a year is less than the total revenue gained from that student. Therefore, if N students fail after spending an average of K years at the university [assume a normal degree takes four years], the total loss of revenue to the university will be

$$T = £N(4-K)(F-M)$$

where F = revenue from fees per student

M = marginal cost of educating one student for one year.

which may turn out to be a very large figure. Thus a successful research project which reduced failure could be economically profitable to a university.

Finally, in the UK each university receives a government grant based on the number of students at the university. It is therefore of paramount importance to the university to maximise the number of students who remain at the university through to graduation.

2.2.1 Models of Performance

Bartholomew (1975) describes two types of model: predictive and descriptive. There have been some purely descriptive studies of performance (eg Astin (1977)), but most studies have attempted to predict performance. However, we have seen that most failure occurs during the first year, so to predict failure in this period we are restricted to the use of those variables which are readily available on a student's entry to university. Variables such as neuroticism or social habits at university should really be described as descriptive variables. Within the framework defined above we are attempting to identify those students who are most likely to perform well at university and those who are likely to perform poorly. Nisbet and Welsh (1976) call such a system an "early warning system" which aims to aid the early identification of students "at risk" of failure. Much work (eg Choppin et al (1973), Powell (1973)) has considered which variables are the most relevant predictors of academic success on a student's entry to university.

For a long time much of this predictive work was based on the premise described by Miller (1970a):

> "The high failure rate ... has led in the past to a search for better ways of selecting students. The assumption has been ... that if 'better students' could be found the failure rate would be much reduced".

As we have already mentioned in 2.1.5, many of these studies have observed "good" students failing and "poor" ones passing. The net conclusion has been that a substantial reduction in the failure rate by changing selection methods is impossible.

Recently, there have been a number of studies which have combined predictive and descriptive methods to lower failure rates (eg Nisbet and Welsh (1976)). This approach, which will be adopted in this thesis, has two phases. Firstly, we use a predictive model to identify those students who are most likely to experience difficulty in successfully completing a university degree course. Secondly, a descriptive model is used to decide how best to help these students overcome the problems they are likely to face.

2.2.3 The Validity of International Comparisons of Performance

The problems involved in making comparisons between further education systems have already been introduced in 2.1.3. We will now consider the validity of comparing British and American or Australasian studies of predictors of academic performance.

Whelan (1980) cites Schmithoff (1939) as saying that there are three requisites for a comparative process to be valid. Firstly, the topic must be comparable; secondly, regard must be made to its social implications; and thirdly, an analytical classification of an impartial and purely scientific character must be applied to the matters under investigation.

To what extent are the British and American tertiary education systems comparable? On a superficial examination they appear to have little in common. Table 2:1 shows that a much larger percentage of the age group enter tertiary education in America than in Britain; transfer between colleges is more acceptable in America; American colleges offer a "baccalaureate" degree which is broader and less specified than a British Honours degree. Many large studies of academic performance in America consider the whole of the tertiary sector – from two year community colleges to prestigious universities. Finally, entrance is based on a system of aptitude testing (Angoff (1971)) rather than on a system of subject oriented examinations.

Objectively, then, it makes little sense to compare American and British studies. However, to turn to the second of Schmithoff's criteria it becomes apparent that under certain conditions it will be valid to compare certain factors. Much research on both sides of the Atlantic involves studies of the relevance of certain variables such as sex, faculty of entry, motivation or study habits as predictors of academic performance. If we assume that the pressures on students to succeed are similar, that there are similarities in the methods of assessment, that we restrict our comparisons to four year American universities (rather than two year teacher-training or liberal arts colleges) and that, importantly, the studies are valid in their own countries, then it is valid to compare and to use American research in harness with British.

Finally, if we are to compare studies from different countries it is essential that the variables under question are matched as closely as possible so as to preserve the validity of the comparisons.

Many of these criteria for comparison are similarly applicable to comparisons between British and Antipodean research. There are a number of similarities: entrance to an Antipodean university is through a subject oriented examination; the degree structure is more like the British (and especially the Scottish) than is the American system; and there are many British roots in Australasian society. However, there are certain important differences that require consideration. Failure rates in Australasia tend to be high. This is partly because the first year of university is used as a quasi-matriculation year with entry into Honours dependent on performance in this year. Again, however, within these constraints careful comparisons are valid.

Finally, it is common for inter-institution comparisons to be made within countries. Table 2:2 shows there are large inter-university differences in failure rates in Britain. It is important that great care is taken when generalising results from one university to the overall population of universities, especially with respect to the ability of the entrants to different universities.

In summary, it is fair to make international and inter-university comparison, but only if great care is taken to understand the assumptions underlying such comparisons. To compare requires a detailed and profound understanding of the foreign system. The effects of different predictors of academic performance in their own environments should be assessed before transplantation.

2.3 VARIABLES ASSOCIATED WITH ACADEMIC PERFORMANCE: AN OVERVIEW

We are now in a position where, having established the problem and the terms of reference within which we will study it, we must consider the variables which have been associated with academic performance at university.

A large number of variables have been considered in studies of academic performance. In this review we divide these variables into those which are predictive and those descriptive. We define predictive variables as those which may be identified at the start or early on in a student's university career, and may be used to estimate the probability of the student undertaking a successful university career.

Descriptive variables on the other hand are those which help us to understand why similarly qualified students perform better or worse than expected.

The purpose of this section of the review is to consider which of the variables are most relevant as predictors or descriptors. The two groups are displayed in Table 2:9 .

Table 2: 9: Variables associated with academic performance

Predictors	Descriptors
School Qualifications	Study Methods
Social Variables	Extraversion
Aptitude Tests	Motivation
Age	Mental Health
Sex	Anxiety
References	
Residence	

We will consider each of these variables systematically. There are a number of criticisms of such a univariate approach (eg Entwistle and Brennan (1971), Panatages and Creedon (1978)), which argue that it is essential to consider interactions between variables. We will discuss the methodological reasons for this criticism in Chapter 3. With regard to this review, we are interested in the relevance of each variable and so must adopt a univariate approach. In those cases where interactions have been reported in the literature we will discuss them.

As described in Section 2.1, it is essential to define carefully a criterion of university performance. Often the criteria used have been first year or final degree performance (Freeman (1970)). These are sometimes used as discrete and sometimes as continuous variables. We will consider the advantages and disadvantages of the respective approaches in Chapter 3. In the rest of this chapter we will describe only those studies which use some kind of formal academic assessment as their criterion of performance, and will describe each criterion used.

The following sections of the review will initially consider the predictors and then the descriptors. For both groups we will start with those which appear, on the basis of previous studies, to be the most relevant variables.

2.3.1 School Academic Performance

Virtually every study has found that school performance is the best sole predictor of first year performance at university, whatever criterion of performance is used. An obvious reason is that school examinations were the last tests of a similar kind to those experienced in university examinations. Even when final degree performance is considered school examination performance has been shown to be a relevant predictor (Freeman (1970)) and better than all variables except previous university performance (Gill (1971)).

Although school examination performance is used as the main yardstick for university selection in the United Kingdom, there are certain drawbacks to its use as a predictor of university performance. Firstly, not all those students who study for SCE Highers or GCE 'A' levels will go on to university. In the sixth year in both Scotland and England higher education candidates may be in a minority. Hence we will be dealing with a truncated range of the overall Higher or 'A' level candidates.

Two other drawbacks are that the level of preparation a student may receive for university will vary from school to school and that examination standards will vary both between subjects and years. Kelly (1977) attempted to standardise examination difficulty for SCE subjects. She found that language subjects were the most difficult. Similarly, at university there must be differing standards of teaching and assessment between both universities and departments within universities.

Many of the academic performance studies have taken place in one department in one university. If we find the results are consistent for different departments and in different universities then we may conclude that the variable is, in general, a relevant predictor.

Initially we will consider the studies which investigate the use of SCE performance as a predictor and will then discuss those which use GCE 'A' level performance as a predictor. Finally, we will investigate the evidence from overseas, which will confirm that school performance is the best available predictor of university performance.

2.3.1.1 SCE performance as a predictor of university performance

Let us start by considering those studies which investigated the association between the Scottish Leaving Certificate (SLC) and university performance. The SCRE (1936) report considered several types of entrance qualifications as predictors of the performance of 347 Scottish qualified entrants. The mean number of passes in the SLC was found to be higher for honours than for ordinary graduates. That for ordinary graduates was found to be the same as for those who did not graduate. When they considered the number of failures in degree examinations at university they found that those with no failures or a lot of failures had many or few SLC passes. However, in the middle of the scale there was more confusion.

An overall measure of each student's school performance was calculated by amalgamating his or her best four school subjects. There was a definite relationship between this measure and degree performance. Sixty-five per cent of those with high entrance qualifications gained a good Honours degree as opposed to three per cent of those with poor entrance qualifications. Again there was some confusion in the middle of the scale. For example, the mean entrance score of the failures was found to be higher than for those who gained an ordinary degree.

Since the late 1950's, there have been twelve Scottish studies, eleven at Edinburgh, Aberdeen and Glasgow. Gould and McComisky (1958) studied 674 Scottish qualified entrants to the Arts faculty at Edinburgh. They showed that those students with the top ten per cent entrance qualifications performed much better than other entrants. Forty-eight per cent of the top group gained a first or second class as opposed to 27 per cent of the other students and only seven per cent of the top group did not complete their course as opposed to 13 per cent of the others. The differences were significant at a 1% level. Furthermore, there was a significant difference in the university performance of those students with the minimum entrance qualification and those with qualifications above the minimum. However, their results confirm our previous observations that there would not be a great improvement in the overall pass rate if we simply raised selection levels. Of those who entered with the minimum entrance qualifications, 77 per cent actually gained a degree, 14 per cent of them with honours.

Also in the Arts faculty, Pilliner (1960) found overall correlations of between 0.3 and 0.4 between SCE performance and degree results. Ross and Montgomery (1961) did not find many interesting results in their study of 484 Arts students, but of those who were exempt from one of their first year subjects they report that GCE students as a group performed slightly better than SCE students, but they do not report significance tests.

In the Science faculty Craig and Duff (1961) considered 1220 students who entered between 1954 and 1959. They concluded that it was not possible to predict performance on the basis of the total number of Highers passed. Their main result was that 74 per cent of the Scottish qualified students who failed did so in their first year, as opposed to 21 per cent of the GCE students. It should be noted, however, that the number of GCE failures was small (19).

Moodie (1959) cites Robb (1956) who, in an unpublished study of Glasgow University entrants in 1951 and 1954, found that most of those who failed their first year had poor SLC marks in Mathematics and Science.

At Aberdeen, Nisbet and Welsh (1966) confirmed the association between university performance and school academic qualifications. They found that in 1964/5 9 per cent of Scottish entrants to the Science faculty who had six or more Higher passes failed their first year as opposed to 42 per cent of those with four Higher passes. They also found a difference between those Scottish entrants who had achieved their entrance qualifications by the end of their fifth year and those who needed an extra year to complete the requirements for entry to university. The subsequent university performance of the former group was much better than that of the latter. However, we will see that, at St Andrews, much of this relationship can be explained by the fact that the overall standard of the qualifications of those who need a sixth year is much lower than those whose Higher qualifications are of a standard which permits university entry after fifth year.

Wilson (1969) also found that school performance was the best predictor of success and failure at university. He divided his sample into categories based on sex and faculty, and reports that the relationships of both the number of SCE passes and the grades obtained with passing or failing first year were significant at the 5 per cent level for each group. The number of passes was also a significant ($p < 0.01$) predictor of failure in the final degree examination in the Arts faculty.

More recently, Jones, Mackintosh and McPherson (1973) considered the cohort of entrants to Edinburgh University in 1969/70 with SCE qualifications, and calculated correlations between first year marks in various subjects and SCE performance. Correlations were higher for Science subjects than for Arts subjects and ranged from 0.28 to 0.53 and 0.05 to 0.44 respectively. The worst correlations were in the Social Science faculty.

Powell (1973) found that school qualifications were the best predictors of academic performance in his study of 9007 Scottish schoolchildren, as did McPherson (1975) at Edinburgh University.

2.3.1.2 CSYS

In 1966 the Scottish Certificate of Education Examining Board (SCEEB) introduced the Certificate of Sixth Year Studies (CSYS). It was not intended as an entrance qualification for higher education but was:

> "to promote the educational maturity of sixth year pupils and to give direction and focus to sixth year work by encouraging pupils who have completed their main subjects at the Higher grade to engage in independent study in depth in a particular subject"
> (SED 1966)

However, most of those who take CSYS do go on to university. At the present time there is much debate on the structure of the sixth year and the optimum form of the CSYS. We will consider this debate in Chapter 8.

Only four studies have considered the relevance of CSYS as a predictor of academic performance. Nisbet and Welsh (1976) considered the success of an 'early warning' system at Aberdeen and found that 40 per cent of the failures were not identified as being 'at risk' while 76 per cent of those 'at risk' at Christmas were successful. When they looked at these two groups they found that the only predictor of success was whether or not the student had taken CSYS examinations.

Hoare (1973) considered the impact of the CSYS examination on Chemistry performance in Scottish universities. He found that in most universities students who had taken a CSYS course performed better in the June degree examination than those without CSYS. This was true even when the students were controlled by their grade in the Higher Chemistry examination. He also found that those students who retook their Higher examinations and improved their grades did as well as those with CSYS.

The main work on the CSYS has been by McPherson and Neave (1976). This book concentrates on an evaluation of the sixth year in Scottish education. They consider the effect of having undertaken a CSYS course on the performance of first year students at Edinburgh University in 1972/3. Unfortunately they consider only entrants with SCE qualifications who had completed a sixth year and so no comparisons were possible with those who entered university direct from their fifth year. Unsurprisingly, they report that those students who took CSYS subjects tended to have better Higher grades than those who were repeating Highers in their sixth year. They report that after controlling for ability those students with CSYS did better than those without only in certain Science subjects. In the Arts faculty, only European History students, and in Science Mathematics and Physics students benefited from taking respectively History, Mathematics or Physics CSYS subjects. Furthermore, they suggest that it is not CSYS that is failing the universities, but that the university first year courses are not appropriate to the aims of the CSYS courses. There are many reasons why most CSYS subjects are not good predictors of first year performance. We will discuss these later.

Houston (1975) looked at CSYS Physics students who entered university outside Scotland. He found that they were much better qualified than Scottish entrants to Scottish universities and that they performed better than comparable English students at the universities.

2.3.1.3 GCE 'A' level performance as a predictor

There have been a large number of studies of the relationship between GCE 'A' level performance and attainment at university. Many of them have been small studies in just one department or faculty and in one year. It is not surprising that there is a lot of discrepancy between the results ; as Nisbet and Welsh (1966),in the study at Aberdeen discussed above,state:

> "The predictive value of different aspects of entrance qualifications fluctuates from year to year and between faculties".

It is essential if valid inferences are to be made from a study, even within the confines of the university in which it took place, that it is replicated on different years and subjects.

Among the earlier studies were those by Williams (1950), Foster (1959), Austwick (1960), Nicholson and Galambos (1960), Petch (1961, 1963), Barnett and Lewis (1963), Himmelweit (1963), UCCA (1967), Pilkington and Harrison (1967) and Bagg (1968, 1970).

In order to understand fully the comparisons reported below it is necessary to discuss the nature of the criteria of university performance used in these studies. We will discuss the statistical implications of the various scales in Chapter 3 but we will introduce them here.There are two main criteria of university performance : First Year Performance and Final Degree Classification. Those studies which consider First Year Performance tend to use a pass/fail criterion of performance (e.g. Choppin et al(1973)). The exceptions use either examination marks (Nicholson and Galambos(1960)), a linear scale based on a subjective rating from the students' tutors (Freeman(1970)) or an additive scale based on the grades awarded in the students' first year examinations (Gill(1971)). The Final Degree Classification gained by a student is, with two exceptions, always represented by a linear scale ranging from a First to a Fail. The exceptions are Barnett and Lewis (1963) who use a canonical analysis to assign values to each degree classification and Gill (1971) who assigns a nonlinear scale subjectively.

The results of many of these studies are not conclusive. Williams obtains the highest correlations but his samples are very small. Some of the other studies, eg Austwick, compared the mean mark in GCE examinations with the class of degree obtained at university. Austwick found a clear relationship with 89.1 per cent of those with the highest entrance qualifications gaining an Honours degree as opposed to 54.7 per cent of those with lower school qualifications.

The UCCA report compared 'A' level and degree performance for 9,000 entrants to university in 1963 who had graduated by 1966. They showed that students with two good 'A' levels ('A' or 'B' grade) performed better than those with three poorer 'A' levels. This may be a reflection that a talent in a specialised area may indicate good performance in the more specialised confines of the university.

Himmelweit (1963) reports two studies of LSE entrants which showed that 'A' level performance in subjects taken at university was no better as a predictor than performance in 'A' level generally. Himmelweit (1965) argues that whether a student obtained 'A' or 'B' grades does not aid prediction as there is a ceiling to the level of prediction that can be obtained, other variation being caused by students developing at different rates.

One of the best statistical studies of the 'A' level/degree performance relationship was by Barnett and Lewis (1963) who investigated data collected by Petch on 2,228 students who took Joint Matriculation Board 'A' levels in 1956. This study has also been reported by Petch (1961, 1963). Barnett and Lewis performed a canonical analysis on a group of variables that included all GCE qualifications. The analysis showed that GCE performance was related to university performance (multiple correlations of 0.40 to 0.45). They suggest that if a single predictor was required, 'S' level performance should be used; if 'S' levels were not taken, then 'A' level performance should be used; if 'A' levels were not taken, then 'O' levels.

Another notable statistical study was by Freeman (1970) who considered scholastic and personality variables on a sample of Reading University students. The scholastic variables included 'A' level marks, a subjective rating out of seven on the Headmaster's report, and a number of binary variables (eg any 'A' levels failed).

He used a number of techniques to predict performance: association analysis, principal components analysis, regression and discriminant analysis on those who passed or failed first year. He suggested that Head's report and student's interests could usefully be used in addition to 'A' level performance and argued that this would be beneficial to potential students as it would take the emphasis away from 'A' level achievement. Personality variables did not prove to be efficient predictors.

Choppin et al (1973) report correlations between 0.22 and 0.49 for school and first year university performance in a variety of subjects except Arts. In the Arts faculty their correlations were only 0.14 for the whole faculty and 0.17 for History. With final degree performance they found correlations between 0.12 and 0.65 . Their highest correlations were in the Engineering faculties and lowest with Arts subjects. They point out that these correlations are not very good, and that the use of 'A' level performance as a selection criterion for university would not be justified if there were better measures available.

Smithers and Dann (1974) at Bradford, Wankowski (1975) at

Birmingham, Abercrombie et al (1969), Whitehead (1974) and Entwistle et al (1970, 1971a, 1971b, 1977) also report similar findings.

2.3.1.4 SCE/GCE studies

Let us now consider those studies which compare the value of SCE and GCE school qualifications as predictors of performance. Five studies mention this comparison.

Gill (1971) in an MSc thesis investigates the comparison for St Andrews University graduates between 1967 and 1970. He reports correlations between 0.27 and 0.60 for SCE Science students and between 0.27 and 0.56 for GCE scientists with final degree performance. In Arts the figures are from 0.32 to 0.42 for SCE students and 0.21 to 0.41 for GCE students.

For multiple predictors based on SCE results he reports a multiple correlation of 0.46 . He finds faculty differences, but states that whatever the faculty there is always a significant relationship between school and university performance. Prediction was improved if account was taken of early university performance.

Kapur (1971,72) studied all first year Edinburgh University students in 1967/8. He found that Scottish students were more likely to fail than students from the rest of Britain, and even when they passed first year they were more likely to be only moderately successful. He also calculated a school achievement score and found that those with higher mean scores performed better at university, while failures had the lowest mean scores. A drawback is that to calculate his school achievement score he uses the scales: GCE: 'A' grade = 5; 'B' = 4; 'C' = 3; 'D' = 2; 'E' = 1 ; SCE: 'A' = 3; 'B' = 2; 'C' = 1 and uses them in direct comparison. His only justification for using these scales is

> "... that one faculty in Edinburgh University was already following this scheme may be taken as a partial justification for the procedure"

which is really no justification at all.

Nisbet and Welsh (1973) studied the 1966 and 1967 entrants to the Science faculty at Aberdeen and St Andrews. They report that the Scottish failure rate in first year was consistently higher than the English failure rate, and that therefore the overall failure rate was linked to the proportion of Scots in the entrant population.

Jones, Mackintosh and McPherson (1973) looked at Scottish/English differences in performance at Edinburgh University. They found that English students performed much better than Scottish qualified students in first year. Of those who passed first year, there was little difference in the final degree results, although a larger proportion of Scottish students took more than the minimum time over an ordinary degree. In Arts these differences could not be explained by individual differences in ability, but were caused by the overall standard of the English entrants as a group.

The overall standard of GCE entrants is very important at St Andrews. The situation is analogous to the selectivity levels as defined by Astin (1977) (see Section 2.1) in that GCE students who decide to enter a Scottish university are making a conscious decision to attend a particular university, rather than simply attending their local university (McPherson 1975). At St Andrews, the standard of 'A' level passes of entrants to the Arts faculty is very high. Houston (1975) in the study reported above demonstrates this selectivity in the other direction for well qualified SCE students choosing to enter an English university.

Thomson (1974) looked at the mathematical knowledge of a group of university Physics entrants. He found that GCE entrants generally performed better than SCE entrants, but that SCE entrants with an 'A' level grade in Higher Mathematics performed better than GCE entrants who had no better than a 'C' grade in 'A' level Mathematics.

Greenfield (1979) compares the performance of SCE and GCE students of Biology at Dundee University and finds that GCE students perform better even after school performance has been controlled by equating an SCE 'A' grade to a GCE 'C' grade, a "B" to a "D", etc.

2.3.1.5 International comparisons

Almost every study in the USA, Canada, Australia and New Zealand has found that school academic performance is the best single predictor of any criterion of university performance. Panatages and Creedon (1978) say that High School Grade Point Average (HSGPA) is an important predictor although correlations are seldom greater than 0.50. They, and Morrisey (1971), make the important point that HSGPA is a good predictor of performance, not of dropping out. This is especially so in a society which has so many transfers. Lavin (1965) states that for 13 studies, the mean correlation was 0.50 with a range from 0.30 to 0.70.

Astin (1975) lists a large number of studies where average high school grade has been negatively related with the unsuccessful completion of university. For his own data he found a significant relationship between school and university performance for each of a number of subgroups (e.g. sex, faculty).

Ingenkamp (1977) lists the correlations between a number of school examination marks and performance at university for 18 studies in German speaking countries. The correlations range from 0.06 to 0.49, although many of the smaller correlations are from studies with a very small sample size (e.g. n = 21).

In Canada, Fleming (1962) reports correlations between 0.22 and 0.60 in Science and 0.19 and 0.67 in Arts for Ontario University entrants, while in New Zealand, Parkyn (1959) calculated a correlation of 0.54 for school/university performance. Schonell et al (1962) report a correlation of 0.48 between school and university performance.

2.3.1.6 Synthesis

Despite the fact that none of the school examinations taken in Britain are intended as university entrance examinations, they provide the best predictors of academic achievement at university.

The correlations reported in the literature tend not to be very high. Some of the reasons for this will be considered in Chapter 3. On the other hand, we would not want, nor expect, a perfect correlation between school and university performance, as many other factors must be involved in a student's success or failure at university.

The main point to become apparent from these studies is that, while school qualifications are the best predictors of subsequent academic performance, and will probably remain as the main selection criterion in the foreseeable future, there is no real justification for raising entrance standards in order to reduce the failure rate significantly. To do so would exclude a number of potential successes. To re-iterate Nisbet and Welsh (1966)

> "Excluding those with the minimum entrance requirements would reduce the failure rate from 16 to 13 per cent, but would also exclude 89 students who would have obtained a degree, 36 of them with Honours".

2.3.2 Social Background as a Predictor of Performance

Jones et al (1973) remark that "it is usually considered to be a test of sociological virility to demonstrate an association between social class and something or other". Many studies of academic performance have attempted to prove their virility but not all have proved fertile. Social class has, in general, been shown to be associated with academic performance, but we shall see that the form of the association is inconsistent. In this section we will describe some studies which use social class as a predictor, and will also consider some other related social variables, eg number of siblings, not all of which have proved to be efficient predictors.

Let us consider social class initially. The early studies were by Dale (1954), who did not find that social class discriminated between different levels of performance; Hopkins et al (1958) and Malleson (1959) who reported that high social class entrants from public schools failed more often than students from other classes. Robbins (1963) reported that, in Scotland, there was a higher failure rate for the children of manual workers than for those of non-manual workers.

Miller (1970) cites Marris (1964) who suggests that children from working class backgrounds are likely to perform better than those from middle class backgrounds for two reasons. Firstly, they are much more highly selected, being less likely to enter university unless they were of exceptional ability. Secondly, working-class parents have to make more sacrifices than middle class parents which may motivate the student to do well. This is supported by Klingender (1955) who found that working class students were atypical of their class of origin.

Dale (1963) has argued that there may be different degrees of selection bias against working class students. His argument is that in subjects where working class students experience more difficulty in obtaining a place, working class students perform better. A lot of work into the effect of social class on academic performance has been conducted at the University of Bradford. Smithers and Batcock (1970) found that when they considered both failure rates and final degree class, students from working class backgrounds tended to be more successful in the faculties of Social and Health Sciences, both of which took a high proportion of students from non-manual backgrounds. Cohen and Child (1969) also investigated failure at Bradford. They found that in faculties with a large intake of students from manual backgrounds (eg Engineering), children of manual workers performed less well than those of non-manual parents.

Kapur (1971) found no relationship for males, but females from manual backgrounds performed significantly worse than those from non-manual backgrounds. Also at Edinburgh, Jones (1972) reported that the odds that students with fathers in non-manual occupations would take honours were 2.2 times those for students with fathers in manual occupations. Jones et al (1973) found that when ability was controlled, correlations between social class and performance for SCE entrants in four faculties ranged from 0.13 to 0.32, the highest being in Engineering. They found no relationship in a fifth faculty, Pure Science.

At Aberdeen, Wilson (1969) found social class was related to performance in the Arts faculty, but that the relationship was not very strong ($p < 0.10$).

The American evidence replicates some of the inconsistencies of the British research. Lavin (1965) reports 19 studies, 13 of which found that social class was positively related to academic performance.

His results agree with Dale's argument in that the 13 studies were from institutions of low selectivity which have higher proportions of entrants from working class backgrounds, while the six studies which reported a negative relationship between social class and academic performance were from institutions at the upper end of the selectivity scale. Astin (1975) finds a negative relationship between social class and academic performance and cites Cope (1968) and Trapp et al (1971) who found similar results. However, he does not consider the selectivity levels of the institutions under question. Werts (1968) and Sewell and Shah (1967) both report sex differences interacting with social class. Werts found that working class boys were more likely to enter higher education than their middle class contemporaries while Sewell and Shah found that social class was relatively more important than school achievement in predicting college goals and achievements for males. Finally, Morrisey (1971) found that students from the lower social classes performed fairly well.

In Australia, Sanders (1961) reports that entrants from the higher social classes tended to have a higher rate of graduation. On the other hand, Gray and Short (1961) and Maclaine (1965) report a negative relationship. Schonell et al (1962) suggest that working class students may have greater problems adjusting to university life as their home background is less conducive to learning effective study methods.

Miller (1970) suggests that the reason that Australian working class entrants generally perform less well than middle class entrants is that very few working class entrants in some states enter university (eg in Queensland only 5.2 per cent of the entrants were from the working class). He says that this will make the Australian entrants feel very much more of an "odd man out" than would a British working class university entrant.

Many other studies (eg Nisbet and Napier (1969), Entwistle and Wilson (1977)) have reported that they found no evidence of a social class differential. There are, then, a number of apparently mutually contradictory results. Dale's argument is one of the few that is plausible although Miller (1970) disagrees with this in Queensland. A major criticism of the literature cited above, which prevents thorough analysis is that very few control for variations in the school qualifications of the entrants. It may be argued that a 'C' grade from an inner city comprehensive may indicate greater potential than a 'C' grade from a highly esteemed direct grant school. Unfortunately the literature does not really help us to answer this question. In summary, further research is needed to identify the complex causes of these differences.

A number of other social variables have been related to academic performance, but few have provided an efficient prediction of academic performance. A major explanation is that many are closely associated with social class and when they are used in conjunction (say in a multiple correlation) with social class, they do not add significantly to the prediction. For example, McCracken (1969) in a study of Leeds University students reported a negative relationship between family size and academic performance; it is possible that his relationship reflected an underlying social class relationship.

With regard to many of these associated measures of social and family background, eg parental education, family size, school type, they are highly associated with social class. The use of these variables in addition to social class as predictors of academic performance is analogous to a relationship we will observe between aptitude tests and school qualifications. They are supplementary predictors that will usually add little predictive capacity to a model.

2.3.3 Aptitude Tests as Predictors

Although aptitude testing has been well-established in the United States for many years (Angoff (1971) provides an excellent history), the first reports in Britain were by Eysenck (1947). From a review of 34 studies he concluded that the maximum attainable correlation between intelligence and performance was 0.58 . He thought that aptitude tests specifically designed for students with high ability might raise this somewhat but proposed that school attainment, because it gave an indirect measure of studiousness, combined with intelligence score would be the best predictor.

Other early work was by Himmelweit (1950) who found a multiple correlation of 0.55 between eleven tests of intellectual aptitude and personality and degree results of 232 LSE students. This correlation was significantly higher than that obtained with the college entrance examination. In a later study she tested 669 students who entered LSE between 1957 and 1959 using the eleven tests together with the Nufferno tests of speed and level of intelligence and a test of research ability (Himmelweit (1963)) and reported multiple correlations of between 0.43 and 0.51 . There was little increase in the correlation when demographic variables such as age and social class were added, but there was evidence of some specific relationships between certain tests and performance in Economics, Law and Sociology.

One criticism made of aptitude tests was that they were designed for a much wider range of ability than university entrants. As a result the use of so-called "high grade" intelligence tests was advocated. Heim and Watts (1960) designed a British high-grade test (many of the earlier studies simply used American tests) and administered it to 166 candidates for scholarships at Cambridge, of whom 62 eventually entered. They found that the test was better at selecting potential firsts than potential failures (perhaps due to its difficulty) and reported rank correlations of 0.43 between the test and first year performance as opposed to 0.57 between the entrance examination and first year performance. They suggest that a good method might be to search for discrepancies between entrance examination and test performance, as this would identify those who had "crammed" to pass the examination and might therefore experience difficulty upon entry to Cambridge. Pilkington and Harrison (1967) also found that 'A' level grades gave the best prediction of university performance among students at Sheffield, and that little was gained by combining a test score with school performance.

The partial success of studies such as these, together with the discussion of the Robbins Committee (1963), which said:

> "There should be research by an independent body into the extent to which aptitude tests might supplement other features of the selection process"
> (para 232, p 277)

led to the setting up of two large scale research studies, one in England and one in Scotland. The two studies had similar aims. They wanted to obtain supplementary predictive information in the form of head teachers' estimates and aptitude tests to enable higher education admissions officers to have evidence beyond 'O' levels on which to base conditional offers.

In Scotland, Powell (1973) administered an American Scholastic Aptitude Test (SAT) to 9,007 students from 281 schools in 1962, of whom 2,781 entered university in Scotland. He used multiple regression with the dependent variable being the simple pass/fail dichotomy of university performance. The independent variables were a number of measures based on school performance, teachers' estimates of Higher performance, headmasters' estimates of degree potential and scores on the verbal and mathematical SATs.

He found that simple correlations between aptitude tests and degree results lay between 0.00 and 0.27 . Using the aptitude tests as supplementary predictors gave increases of between 0.04 and 0.09 for different faculties with the largest increase in Law.

One reason for the low level of the correlations must be the criterion of performance used. Correlations including a dichotomous variable tend to be low and are hard to interpret. It would have made for a more informative investigation of SATs had this study used a more refined criterion of university performance. However, there is no evidence that the use of such a criterion would have led them to conclude other than

> "... the investigation has provided no grounds for supposing that the introduction of a Scholastic Aptitude Test such as the one employed would be of any value in selection ..." (p 41).

In England, 65,000 lower sixth formers took a British version of the SAT developed by R A C Oliver which is known as the Test of Academic Aptitude (TAA) which is made up of a verbal and a mathematical subsection. Of these 27,315 students were followed up, 7,247 of whom entered university in 1968 and were included in the analyses (Choppin et al (1973)). Simple correlations between the TAA and first year university performance (graded on a six point scale by university tutors) ranged between -0.13 and 0.30 . The highest correlations with the mathematics section of the TAA were for mathematics and physics students, but none of these was greater than 0.2 . For overall degree performance the correlations ranged from -0.12 to 0.32, the highest correlation being between the mathematics section and engineering.

When multiple correlations were considered, addition of the TAA score raised the multiple correlation between degree performance and a combination of 'O' and 'A' level and school assessment measures from 0.40 to 0.42; this increase is not significant, though. They conclude:

> "TAA appears to add little predictive information to that already provided by GCE results and school assessment in general. There are indications, however, that in certain fields of academic study it can be quite valuable" (para 9, p 63).

Entwistle and Wilson (1977) describe a study of entrants to the Arts and Science faculties at Aberdeen University in 1967. They investigated the Moray House Adult Intelligence Test and the Wechsler Adult Intelligence Scale as predictors of university performance but found them of little use.

Entwistle and Wilson (1977) reporting the Rowntree project describe the use of the TAA to help predict academic performance of 2,569 entrants to Northern English universities in 1968. They report correlations of between -0.04 and 0.29 for degree results with the two subsections ofthe TAA. For both subsections of the aptitude test the highest correlations were with those students taking Mathematics degrees. When they performed an Automatic Interaction Detector (AID) (Sonquist and Morgan (1963)) study of Arts students, verbal aptitude entered at the second split for good students. They also found that a combination of intellectual variables improved significantly the multiple correlation between predictors and degree performance from

0.16 for 'A' level performance alone to 0.33 for the combined group. Of this additional group, verbal aptitude was the most relevant.

They conclude by saying that aptitude tests are probably of most use as aids when comparing the academic demands of different subjects.

"High grade" intelligence tests have also been used in Australia and New Zealand, but with unsatisfactory results. Sanders (1961) tested 313 entrants to all faculties in 1947 at the University of Western Australia, using the B42 high grade test, developed by the Australian Council for Research in Education. There was a correlation of 0.34 between the B42 test and first year results as opposed to one of 0.61 between school leaving certificate and performance. The two results combined produced a multiple correlation with first year performance of only 0.62 . He found that the B42 test discriminated between successful and unsuccessful students better in Arts and Law subjects than in Science subjects.

Parkyn (1959), in New Zealand, found a median correlation of 0.20 with first year performance criteria using a parallel version of the B42, the B40.

Schonell et al (1962) found the B40 scores of successful students at the University of Queensland significantly above those of the unsuccessful students. Small (1966) demonstrated a significant difference between successful and unsuccessful students on the B40. However, he again noted that some poorly qualified students achieved very good degrees, and vice versa.

With regard to the use of aptitude testing as a selection mechanism, Miller (1970b) says:

"SAT type tests may lessen cramming in the schools, but it is doubtful if any reasoning can justify closing the doors of higher education to increasing numbers of qualified school leavers" (p 6).

The country with the most impressive and organised system of aptitude testing is the United States. Summerskill (1962) reported that in 16 out of 19 studies average SAT scores were found to be lower for drop-outs than non-drop-outs. His definition of drop-out from college is somewhat hazy and so different studies may not be directly comparable. Sewell and Shah (1967) also report this relationship.

Some studies (eg Blanchfield (1971)), have not found a difference between SAT scores of drop-outs and non-drop-outs. This may be mostly explained by the simplicity of the definition of non-completion used by these studies: not obtaining a degree at an institution four years after first registration at the institution. Johansson and Rossmann (1973), who use a more sensitive definition of non-completion, observe no difference in the SAT scores of non-drop-outs and voluntary withdrawals, but a significant difference between voluntary and non-voluntary withdrawals.

In Canada, Fleming (1962), for his sample of 3,337 entrants to Ontario universities in 1956, found that SAT-mathematical score made a slight additional contribution to the predictive value of school performance grades when predicting performance in the Applied Science and Engineering faculties. For Arts faculties the SAT-verbal score made no additional contribution to the prediction.

These studies lead one to question the usefulness of SATs as predictors of performance. Astin (1971) argues that the higher the "selectivity level" of the college, the less the usefulness of the SAT score as a predictor. Entwistle and Percy (1974) attribute this to the fact that the grade point average - which is the criterion of performance in America - is the result of students studying a large variety of courses from different areas of study. This is in contrast to England where most students gain an Honours degree in a specific subject; which means we must be wary when extrapolating these tests to an English situation. Perhaps they could be of greater use in Scotland for predicting the success of students taking an ordinary degree. However, as we shall see in Chapter 7, many students taking an ordinary degree at St Andrews University do so as a result of some failure early in their course, rather than in the traditional Scottish quest for a broad education.

In summary, then, there seems to be little justification for using aptitude tests as predictors (either on their own or to supplement other variables) of academic performance. They will not, therefore, be considered in this study.

2.3.4 <u>References</u>

One of the major sources of information available to admissions officersin the selection of students for university has been references, usually in the form of a headmaster's report on the student.

These reports have been used extensively as predictors, especially in Scotland. The SCRE report (1936) used the, then usual, head teachers scale of Ex, VG, FG, F, with + or - options, and investigated the predictive capacity. They found that head teachers' estimates tended to be higher for those students who obtained an honours degree than for those who did not, and those who gained a First tended to have a higher rating than those who gained a second. They found a slight sex difference in overall performance. For example, of those with the school mark VG 56 per cent of the men but only 36 per cent of the females took an Honours degree, although this could simply reflect a sex difference in the choice of degree type. At a lower level, though, headmasters' ratings did not differ between those who took an ordinary degree and those who failed to complete a degree.

Furneaux (1961) asked headmasters for specific ratings on a sample of 2,000 sixth formers in Lancashire. He asked headmasters whether they thought the student would be (a) capable of a good honours degree and/or (b) a pass degree at the first attempt or (c) of neither of them. He found 30 per cent of both the boys and the girls were rated as (a), 60 per cent of the boys but only 40 per cent of the girls were rated (b). This indicates that the head teachers tended to over-rate the potential performance of some boys as more than 10 per cent of the male university entrants in the sample failed. He also asked the headmasters for their opinions of their pupils on nine factors which might deter them from good performance at university. These were such items as 'lack of ability to work hard in a university atmosphere', 'lack of a stable temperament' or 'lack of good health'. He found that 40 per cent of his sample were considered to possess one or other of these factors, and that there were strong social class effects among the girls.

He followed 503 of these pupils on to university and found a correlation of -0.50 between a headmaster's rating of 'lack of ability' and subsequent academic performance and one of -0.23 with 'non-intellectual disabilities'. The headmaster's letters were rated as 'intellectually favourable' or 'non-intellectual qualities', and despite the obvious subjectivity in such assessments there were correlations of 0.32 and 0.17 respectively.

Himmelweit (1963) found that overall assessments of LSE entrants were less reliable than specific ratings of the students' intellectual potential.

In the late 1960's there were two good studies at Aberdeen University. Nisbet and Welsh (1966) classified headmasters' estimates of ability and persistence as either A (of Honours calibre) or B (of doubtful promise). They found that 11 per cent of those rated highly on ability failed as opposed to 27 per cent of those rated poorly. For persistence, 18 per cent of the highly rated students failed and 36 per cent of the lower rated students. For final degree performance there is little discrimination, often due to small numbers in the groups.

Wilson (1974) describes a study based on Furneaux' approach. In May 1968 he asked headmasters to rate their pupils who had entered Aberdeen in 1967 on the nine items used by Furneaux. Two considerations are necessary. Firstly, those students who entered university straight from fifth year would have received a conditional offer from the university. While his or her letter of recommendation would have been written before the student sat Highers, the ratings would be made in the knowledge of the students' Higher results and, therefore, possibly biased by them. Secondly, many Scottish students who stay on for a sixth year leave after receiving an unconditional offer of a place at university. The head teacher is therefore rating a student he or she last had contact with over one year previously, which again could be a source of bias.

Wilson used χ^2 tests to investigate which of the ratings were related to success or failure in either their first year or final degree. The following items from the scale produced the responses which best predicted failure at university. Lack of perseverance, lack of maturity and lack of independence proved to be the most consistent predictors for each subgroup except female artists. For this group lack of intelligence was the only significant predictor of failure. For success, head teachers' ratings proved to be useful predictors for final degree performance among female Arts students. Also, the head teachers' estimate of the students' potential for an Honours degree was found to be a good predictor of success in both first year and final degree performance.

In New Zealand, Parkyn (1959) obtained ratings from head teachers on a five point scale. He reported that although 40 per cent of the students failed, 90 per cent had been rated by their head teacher as capable of obtaining a degree. However, the head teachers' estimates were highly associated with first year performance, ranging from -0.32 to 0.45 for males and -0.19 to 0.56 for females.

Freeman (1970), at Reading, found a subjective assessment of the headmaster's report to be a useful addition to school academic performance as a predictor of academic performance. Addition of the head teacher's report variable always increased the correlation, but never by very much.

Choppin et al (1973) suggest that an optimum predictor may be the teacher's estimates of the grades to be gained by the student. If these were used for selection purposes, then "under achievers" in school examinations could be reconsidered in the light of their teachers' estimates, thereby helping to eliminate the problem of students having a "bad day" in an examination.

In summary, head teachers' estimates have been shown to be associated with academic performance. However many of the best correlations with performance have been for ratings made specifically for a certain study. Predictions based on subjective assessments of head teachers' references have not proved to be as useful. If the "objective" ratings were to become an integral part of the selection process, it is possible that, by becoming routine, their effectiveness as a discriminator between good and poor students may diminish. Furthermore, as we have seen before, many of those rated poorly by the head teachers did successfully complete a degree.

The major use of head teachers' reports must be in identifying those students most likely to be at risk of failure and hence to assist as many students as possible to obtain a university degree.

2.3.5 Age

The literature on the relationship between age differences and academic performance is very contradictory. Barnett and Lewis (1963) found that age could always usefully be included in their prediction equations. The relationship they found was a negative one with older entrants performing worse than younger ones. However, in a later paper Barnett, Holder and Lewis (1968) reconsidered the 1963 paper and discovered that most of the effects they had reported were due to differences across sexes and subjects. Data from Birmingham University also suggested that any age relationship may be a consequence of various sex/subject combinations rather than a general result. They considered age in three cohorts - 17-18, 18-19, 19-20 - and formed a three way contingency table of age × sex × subject for different degree performances. The results showed age differences in Science subjects other than Mathematics, for males in Engineering and Applied Science and for females in Arts. The direction of the relationship was that older candidates performed less well than younger candidates.

McCracken (1969) at Leeds University studied the entrance cohorts for 1965/66/67. In two of the three years, older students performed less well. In England other studies (Forster (1959), Malleson (1959), Howell (1962)) had also found this relationship, but it is important to note that many of those entering university a year late are doing so because they did not get good enough entrance qualifications at the first attempt. Many studies have neglected to control for differences in ability.

In Howell's study the tendency towards better performance among younger students is very slight, but this is based on the overall data. A much better interpretation could be obtained by splitting the sample into subject groups since some subjects attract older students.

In Australia, Sanders (1961) reports that increased maturity due to age and experience aided prediction in English, Philosophy, Law, Psychology, History and Economics.

We should now consider the distinction between "linear" and "non-linear" subjects. Linear subjects are those which require a building block approach to learning, in that a certain piece of knowledge requires familiarity with previous results. Examples of such subjects are Mathematics and French. It may be seen that all the subjects listed by Sanders are non-linear. It has been suggested that for such subjects extra age and maturity are positive aids to success at university. Orr (1974) argues that a year off between school and university may be beneficial in some subjects.

The situation in Scotland offers a chance for comparison between fifth year entrants and sixth year entrants. However, there can never be perfect studies without controlling for differences in ability and qualifications. Sixth year leavers will either be better qualified by having taken a CSYS course, or liable to be less qualified on account of having needed two years to attain entrance qualifications.

In America there has been little evidence of any age differences in academic performance. Panatages and Creedon (1978) say that the only evidence of a relationship is reported by Sexton who found that substantially older entrants were less likely to drop out. Astin (1975) says that older students (particularly females) are more likely to drop out (although the proportion of older students in his sample is only 8 per cent). Trent and Medsker (1967) also report that older students are less likely to succeed. Lavin (1965) in his review of the literature reports that no age difference remains after controlling for ability.

To sum up, it seems fairly certain that there is no overall age effect. However, there would appear to be arguments for considering different faculties separately when advising students of the effect of taking some time (eg a year) off between leaving school and starting university.

2.3.6 Sex Differences

Many studies have not considered this vital variable often as a result of the small numbers in the study or because they are studying one department, eg engineering, where there are very few of one or other of the sexes.

In those that do consider sex differences, a common finding is that girls are more predictable than boys. For example, the SCRE (1936) study, when considering teachers' estimates of likely performance stated:

> "Boys are more likely than girls to surpass the teacher's estimate when they go to university"

which indicates that at the upper level of academic performance, girls are more predictable than boys.

Sanders (1961), testing on the B42 aptitude scale, showed that females in the Science faculties had a verbal score higher than Arts females and a very significantly higher score on the non-verbal sub test. We will argue later that those females who have overcome all the barriers to taking a science course (see Kelly (1978)) must really want to take a science course and are less likely to have "drifted" into the Science faculty than into an Arts faculty at university. This is supported by Weitz, Clarke and Jones (1955) and Weitz and Colver (1959) who found, in large samples, that girls were less likely to be motivated than boys into taking a specific subject. When we consider that most girls enter Arts faculties and that it is much less likely that they will be able to pursue a Science based course at school, Sanders' result gains credence.

Wankowski (1973), in an extensive study of the temperament and motivation of a random sample of Birmingham University students, found clear sex differences. For example, male performance was negatively correlated with extraversion while female performance was negatively correlated with neuroticism. Also, females were significantly more rigid in their attitudes to learning than males in that they tended to rely on the methods of study they had learned at school.

Recently, there has been a greater awareness of sex differences, aided no doubt by the increasing percentage of girls entering university in Britain. Wilson((1969) and in Entwistle and Wilson (1977)) performed all his analyses separately for different sexes and faculties. He found that 40 per cent of the Arts men failed a course at some stage of their career, compared with 52 per cent of Arts women, 51 per cent of Science men and 54 per cent of Science women. The study showed that for first year performance, the accuracy of prediction is the same for all groups except Science women who were excluded because of lack of numbers. For overall degree performance, there is better prediction for Arts women and Science men, while for Arts men the level of prediction is the same as for first year. For a Science woman the only clear predictors of success were standard of SCE passes, whether the head teacher thought she would gain an Honours degree and the level of her performance on the head's check list.

When Wilson considered the prediction of failure he found that Science women had the fewest "symptoms". Arts women had a poorer level of prediction for their overall degree performance than for their first year performance. Residence in the university region was a predictor of failure in Arts women, but was a predictor of good final degree performance in Science men. This is another indication that lesser qualified girls 'drift' into a local university.

Entwistle and Wilson (1977), in 'The Rowntree Project', reported that ambition was a good predictor of performance both for men and women but was linked with neuroticism in women and the extent to which the student worked hard.

At Edinburgh Jones (1972) reports that the odds of men taking honours are 2.2 times those of women. Jones et al (1973) also report that women under-achieve in Arts and Law which they attribute partly to a lack of confidence in one's ability to meet first year standards and in lower aspirations for honours amongst women. They also found that women did not under-achieve in Pure Science or in Non-Vocational Social Science.

Choppin et al (1973) also considered sex differences. They report that for first year performance in Science women are more predictable than men. Correlations with mean 'A' level performance were 0.45 for women and 0.30 for men, and this higher predictability follows through for multiple predictors. In Arts there is no consistency in the results. For final degree performance, women students were less likely to fail than men, but the differences are only significant in Mathematics and Chemistry. Among those students who performed very well women performed slightly better than men, but the differences were very slight.

In America, Astin (1975) describing his study of 41,536 students found that women were more likely than men to graduate in four years and were also more likely to graduate in the long run. Cope and Hannah (1976) find some discrepancies in the research with men doing better than women in some studies and vice versa in others. Peng and Fetters (1978) in a study of 6,000 students found no evidence of sex differences.

The main sex difference in American studies is manifested in studies which consider the reasons for non-completion of a course. Astin (1975), Cope and Hannah (1976) found men are more likely to report that poor grades or boredom with courses were their prime reasons for leaving, whereas women are more likely to state that marriage was a reason for giving up college. Douvan and Kaye (1964) say that women were more likely to view college as an end in itself whereas men were more conscious of vocational goals as reasons for going to college. Johansson and Rossmann (1973) also found sex differences in reasons for dropping out.

There appears to be some confusion over the relationship of sex to academic performance. One of the main reasons for this is the paucity of the literature which considers it as an important variable. Wilson's work is the most comprehensive, and Choppin et al add some useful results. The one major conclusion from the literature seems to be that women are less likely to fail than men. In Scotland the traditional female route of an ordinary degree followed by college of education biases comparisons of overall performance. However, this trend has been changing (McPherson 1973) as both more women are entering university and taking Honours degrees and therefore it becomes even more essential to consider potential sex differences. We will discuss this trend in Chapter 7. Finally, the need to consider sex differences in performance studies is summarised by Wankowski (1973) who says:

> "Any results of analysis which, for the sake of large numbers, are confined to mixed populations should, of course, be regarded as begging an obvious

question: "What happens to this trend when males and females are treated separately?"".

2.3.7 Other Background Characteristics

There are a number of other background variables which have been used to predict academic performance, but without a great degree of success. The first of these is religion. In America, strong religious values consistently correlate positively with graduating. Astin (1975) reports that Jewish students are the least likely to drop out followed by Catholics. In Britain, Entwistle and Wilson used a religious values subscale in 'The Rowntree Project' and observed correlations between -0.04 and 0.05 for all subjects except languages where values of 0.18 for first year performance and 0.23 for final degree performance were calculated. This latter result is not interpreted.

Secondly, type of residence at university (eg flat, hall of residence) has been considered by a number of studies. Jones et al (1973a) investigated the relationship between place of residence and first year academic performance at Edinburgh in 1970. They found that those living in a hall of residence did best, followed by those staying at home and finally those in lodgings.

Pike and Gardner (1975) reported that of a cohort of Reading University students, 31 per cent replied that a desire to leave home was a reason for not going to their local university. At the same time, 33 per cent (not necessarily mutually exclusive) stated that the course they wanted was not offered at their local university. Flynn (1976) stated that an enforced policy of students living at home could cause considerable problems in the social and academic lives of certain types of students. This could cause increased failure.

The extent to which students participate in extracurricular activities and their relationships with their fellow students have been studied with inconsistent results. Lucas et al (1966) and Himmelweit (1950) both found that poor performers did not take part in many social activities. On the contrary, however, Marris (1964), Gray and Short (1961) and Malleson (1963) found the opposite to be true. Hendry and Douglass (1975) report that girls who participate in sport performed better academically than those who did not.

The problem seems to be one of acceptance. Those students who settle down to university life and make friends adjust to working in a university atmosphere more smoothly than those who do not. To overcome such problems, research is not needed so much as concerted efforts by the university to assist its entrants to adjust to university life as smoothly as possible.

There are other variables associated with the prediction of academic performance, but these are often very specific to America, eg financial problems, and have little to offer the British system. In summary, it seems that none of these variables is a good predictor of performance.

2.3.8 Personality

Panatages and Creedon (1978) say that drop-outs have been described in American studies as:

> "aloof, assertive, critical, disagreeable, immature, impulsive, impetuous, nonconforming and unconventional, likely to over-emphasize personal pleasures, rebellious against authority, resentful of college academic and social regulations, self-centred,

lacking self sufficiency, uncertain about the future and more uncooperative".

The adjectives given to good and poor performers in British studies are almost as numerous. This part of the review will be divided into four sections: (i) Motivation, (ii) Anxiety, (iii) Sociability and (iv) Mental health. This part does not aim to be exhaustive, but will attempt simply to give an overview of the main findings.

2.3.8.1 Motivation

There has been a general agreement in recent years over the relevance of motivation as a descriptor of academic performance. For example, there is little doubt that a difference in a student's motivation in going to university between wanting a degree and wanting to be at university is likely to predict final performance.

The literature on motivation is well documented. Entwistle, Thompson and Wilson (1974), Entwistle and Wilson (1977) and Wilson (1969) all describe the development of the measurement of motivation as a predictor of performance.

The early theory on motivation was defined by Peters (1958) who suggested that it was necessary to consider extrinsic and intrinsic motivation. Extrinsic motivation is defined as goal-orientated - a present for a job well done - while intrinsic motivation is motivation from the task itself.

Extrinsic motivation has been measured in a number of different British studies by questions about the student's reasons for entering university. Studies by Hopkins et al (1958) and by Wankowski (1969, 1970, 1973) have shown that poor performers are more likely to have entered university for goal orientated reasons (eg, wanted a good job) as opposed to successful students who report more intrinsic reasons. Jones et al (1973b) argue that teachers and examiners determine which criteria define good or bad performance in a subject, and that well-motivated students will recognise the qualities that are required to perform well in the examination. They also considered the relevance of other measures of motivation (eg, "having a job in mind") as subsidiary predictors of academic achievement. Their results show a distinct faculty difference. Successful Psychology students were more likely to have positive reasons for entering the university (eg, vocational) whereas high performing sociologists gave negative reasons (eg, "it put off a career choice"). They highlight an important methodological point when they note that the same motivational variable may have a different effect in different subjects, and criticise Wankowski (1973) for having ignored this.

Choppin et al (1973) agree that motivation would probably have an effect on the performance of their sample in the SAT tests. They compare the results with those of a sample of Rhodesian university entrants in 1969 who, they say, sat the test under extrinsic motivation (it was used as a selection instrument). They found that the results were similar for both groups and conclude that the British results were acceptable.

Smithers (1973) found that, at Bradford, 39 per cent of failures who entered in 1966 were worried about their career prospects as opposed to 17 per cent of those who passed. He concludes that occupational motivation is an important factor in predicting failure. It may be more true that those who fail perceive their difficulty with their courses and are worried about their prospects of a career should they fail. Those who feel confident of passing may postpone such decisions for at least another year.

Intrinsic motivation came to prominence with McClelland (1953) who suggested need for achievement (n-ach) as a major predictor of academic performance. McClelland used thematic apperception tests to measure motivation. These tests are performed by giving the subject a group of drawings of ambiguous situations and asking the subject to describe the situation. These descriptions may indicate an underlying need for achievement. There is great difficulty in measuring the level of n-ach from such tests. Lavin (1965) reports that the use of such tests has not consistently improved the prediction of different levels of performance.

More recently a number of questionnaire type indices of n-ach have been developed, notably by Mehrabian (1968) whose scale has both a male and a female form. In Britain specific scales of academic motivation and study habits have been developed (Entwistle, Percy and Nisbet (1971)). Both these scales have shown consistent relationships with degree results across different subject areas, work described by Entwistle and Percy (1974).

Entwistle and Wilson (1977) used the Student Attitudes Questionnaire (SAQ) and found that motivation was a good indicator both of good performance and of failure at Aberdeen. For example, high motivation was a good predictor of success in final degree for male Arts students. They also say that motivation appeared to be a better predictor than study methods (questions on which comprised the other half of the questionnaire), particularly for men.

Wilson (1969) cites Nisbet and Napier (1969), who found that successful students at Glasgow University were more likely to report that they were extremely "keen" on entry than those who performed poorly. The Rowntree Project (Entwistle and Wilson (1977)) used the

SAQ and found that the association between motivation and performance increased between first and third year, the median correlations across a number of subjects rising from 0.19 to 0.25 . However the use of cluster analysis indicated that in some subjects changes in motivation accompanied changes in academic performance rather than causing such changes. They argue that changes in attainment might be affecting the level of motivation. They conclude:

> "certainly motivation will explain the subsequent academic performance of some students, but there is no uniformity and the direction of causality may well be reversible".

In summary, it is fair to say that there is general agreement as to the relevance of motivation as a predictor of academic performance. However there is, firstly, great difficulty in measuring motivation accurately. Secondly, the likelihood that motivation will be at different levels in different subgroups may be a cause of the poor correlations between overall scales of motivation and academic performance. Possible solutions could be to consider subgroups and then develop different scales for different groups. Also, too many of the studies have been on too small a scale. It is to be hoped that results from the present national survey being administered by the Centre for Research into Post Compulsory Education at Lancaster (Entwistle et al (1979)) will permit a greater understanding of the subgroup differences.

2.3.8.2 Anxiety

The research on this predictor of academic performance owes much to Eysenck (1957, 1965, 1970, 1972) who sees neuroticism as being characterised by unnecessary worrying, feelings of restlessness, moodiness and general nervousness. He interprets neuroticism as being a drive which elicits behaviour likely to reduce this state of stress. This could mean that neuroticism should be positively related to academic performance, but Eysenck argues that according to the Yerkes-Dodson law (1908) a moderate amount of neuroticism induces high performance, but too little or too much is not conducive to good performance.

This implies that there should be a non-linear relationship between anxiety and performance. The only studies to have confirmed this relationship have been by Lynn and Gordon (1961) and Savage (1962) and both these studies used small, unreplicated samples. Furneaux (1962) and Kelvin et al (1965) found positive relationships between neurotic introverts and performance, high negative relationships between neurotic extraverts and performance.

Lavin (1965) and Eysenck (1972) make the important point that indices of anxiety measure general anxiety whereas actually anxiety may be related to specific situations (eg examinations) which may account for low correlations between anxiety and performance. The best correlations for general anxiety were found by Wankowski (1973) who calculated a correlation of -0.37 between anxiety and academic performance.

Wilson (1969) found that low stability was a good predictor of academic failure among women, but not men, in final degree performance. He found very low correlations in all areas of study between neuroticism and academic performance and, not surprisingly, low weights for neuroticism in the multiple regression analyses.

Entwistle and Wilson (1977) report a study of 72 students in which they investigated motivation and personality with respect to degree results. They found no relationship between neuroticism and degree result, and also no difference when they split the sample by extraversion and intraversion as measured by the Eysenck Personality

Inventory. This lack of any relationship between neuroticism and performance was also found by Smithers and Dann (1974) who studied 459 entrants to the Engineering Science and Language faculties at Bradford in 1966.

Entwistle and Brennan (1971) report a study of 862 students. They utilised cluster analysis on 23 variables comprising academic variables, personality variables, study habits and personal values. The clustering technique was the K-means procedure (Wishart (1969)) with euclidean distance as the dissimilarity measure. This technique requires that the researcher chooses the maximum number of clusters to be formed. Entwistle and Brennan chose 15 and decided that the most stable solution was to use the first 12 formed. They then ranked the clusters according to the mean performance of the students in each cluster. Two of the three "high attainment" clusters contained stable introverts while those clusters which contained neurotic students were those including students with less than average academic attainment as a group.

Kline and Gale (1971) found no consistent correlations between neuroticism, introversion and performance in a Psychology examination at Exeter University. Smithers and Batcock (1970) found no relationship between neuroticism and performance, while Hoare and Yeaman (1971) report that neurotic extrovert students did less work than stable introverts. The only other real personality difference is reported by Hendry and Douglass (1975) who found that physically active students were more extravert and stable than non-active students and also that physically active women performed better than non-active women, although this does not, of course, prove causality.

Lavin (1965) reviews the early American studies and reports that there was no consistency in the literature when a general measure of anxiety was considered. However, when more specific measures of anxiety (eg anxiety about a specific examination) were considered, the findings suggested that "test-taking anxiety" is negatively related to performance. More recently, Panatages and Creedon (1978) argue that:

> "It is evident that, for methodological reasons alone it would be extremely unwise to include an applicant's score on some personality test among the criteria for admission".

Their argument is based upon the variability in the literature and the lack of agreement on a suitable test of anxiety. Astin has not used personality variables in any of his studies since 1964 when he constructed the California Psychological Inventory which showed that drop-outs were more aloof, self-centred, impulsive and assertive.

In summary, a major drawback in the use of scales of neuroticism and anxiety as descriptors of academic performance is the problem of constructing valid scales to measure the phenomena, and the practical difficulty of measuring anxiety. Again, the recent work by Entwistle et al (1979) may permit the construction of more valid scales. The most profitable method of measuring these phenomena may be through the use of in depth interviews, which may permit a more thorough understanding of the relationship between neuroticism and academic performance.

2.3.8.3 Sociability

Closely tied to neuroticism and anxiety is the parallel personality trait of sociability and extraversion. Most of the early British work stems from Eysenck's Personality Inventory which had an introversion-extraversion dimension. Furneaux (1962) used it to show that neurotic introverts had a 79 per cent chance of success in the first year examination, stable introverts had 74 per cent, neurotic extraverts had 64 per cent and stable extraverts had only a 39 per cent chance of success in first year. Kelvin et al (1965) also found a positive relationship between introversion and academic performance.

Most studies report that introverts perform better academically than extraverts. Wilson (1969) found that, at Aberdeen, high levels of extraversion predicted first year failure among Arts students, but when final degree performance was considered the only worthwhile prediction was for female Scientists. Introversion was a relevant predictor only for first year male Scientists.

Entwistle and Wilson (1977) report correlations in the range -0.01 to -0.19 between extraversion and performance, with the highest correlations in languages and Applied Science, and the lowest in the Social Science faculty. Extraversion or introversion entered seven of Entwistle and Wilson's 15 performance clusters. When the clusters are ranked from 1 to 15 in decreasing order of performance, introversion appeared in clusters 2, 4, 6 and 7 while extraversion appeared in clusters 11, 12 and 13. As we might expect, the weights in the multiple regression analysis showed that "low extraversion scores were clearly associated with good honours degrees" (p 144).

Smithers (1973), reporting the follow-up study of 1966 entrants to the University of Bradford, found that introversion was strongly associated with success in four different faculties. He also mentions a relevant methodological point when he describes a colleague giving the Eysenck Personality Inventory to a group of students applying for admission to one of the schools of the university. The students guessed correctly that the university was, unusually, looking for stable extraverts and the means for these two factors were extremely high. Furthermore, a "lie scale" which is built into the Inventory with the aim of preventing such deliberate answering gave perfectly normal values. This must make one wary of such scales, especially if one has motivated the subjects, perhaps by making the scale part of a selection mechanism.

Entwistle, Thompson and Wilson (1974) describe a set of interviews with a subgroup of 60 students from the Rowntree Project which were designed to investigate pre-university, university and expected post-university experience. Using the students' scores on the EPI, Entwistle et al classified the sample into High and Low, Over and Under Achievers, and found that High Achievers were less extravert than Under Achievers. When they interacted neuroticism with extraversion they found that particularly successful students were often unstable introverts with low motivation and poor study methods or in the totally opposite group of stable extraverts with high motivation and good study methods. The interviews indicated that the unstable introverts were "motivated" mainly by a fear of failure while the stable extraverts tended to report more conventional reasons for their success. It is important to remember, however, that these results come from a sample of 60 of whom only eleven over-achieved, and only 21 under-achieved. Furthermore, there were only seven unstable extraverts and similar numbers in the other personality categories. Hence the small numbers mean that valid statistical inferences are not possible and Entwistle et al are forced to rely on the students' comments in the interviews.

In another pilot study of 72 students, Entwistle and Wilson (1977) also found that neuroticism:stability was of little importance, but that extraversion:introversion discriminated well between successful and unsuccessful students.

The Rowntree Project itself uses a number of attitudinal scales developed by Entwistle and co-workers. These aim to measure a student's Political, Religious, Social, Economic, Theoretical and Aesthetic Values and also his or her Radicalism and Tough/Tender mindedness, but without exception there is little association with academic performance. When the attainment clusters were formed, positive religious values was a member of one high attainment cluster and tough-mindedness one of the low attainment clusters, but none of the others figured prominently.

Foreign studies report similar results. Sanders (1961) cites Olsen (1957) as indicating that a tendency towards introversion is a good predictor of academic success. These findings are replicated in Australasia by Savage (1962) and Small (1966). Lavin (1965) reports that the American literature supports the argument that introversion is positively related to academic success. The main discussion in America has been over the validity of the scales.

In summary, the recent work in Britain, pioneered by Entwistle and Wilson, has generally confirmed Eysenck's contention that extraversion is negatively related to academic performance. However, a great deal of doubt remains over the validity of the scales used to measure an individual's personality. It will always be possible that a student may attempt to identify a desirable trait and answer accordingly. Even if the "lie checks" do identify some dubious results, there must be some doubt over the rest of the sample. For these reasons and also because, as we have seen so often in this review, many of those whom we would predict as being likely to perform poorly do successfully complete a course there appears to be little potential for personality inventories in the selection process. Their main use may be to the counsellor as an aid to the description of a student's performance. The most valid method of measurement is probably the use of in-depth interviews rather than questionnaire inventories, although there are obviously practical difficulties in obtaining large samples using such an approach.

2.3.8.4 Mental health

Dale (1954) reported that the suicide rate amongst students was three times that for the average population. He also found that at the University of Wales, 13 per cent of the students had major psychological disorders and a further 20 per cent minor ones. These figures would be very worrying were they common, but most studies have found the incidence of psychiatric disorder to be much less.

Kelvin, Lucas and Ojha (1965) studied 198 medical students, and discovered that of those who dropped out, or failed to complete their degree in the minimum time, half were psychologically disturbed, usually mildly. However, two-thirds of those who gained first class degrees had similar problems. Malleson (1960) found that ten of his sample of 551 students at University College London had a major psychiatric illness, but of these five passed. A further 101 had a minor disturbance yet all but 16 passed - a failure rate similar to the sample as a whole.

Parnell (1951) studied 6,000 Oxford undergraduates and found that, of the 145 students who lost a term due to illness, 52.5 per cent had had some form of mental illness, which was 1.5 per cent of the total sample. Of those who failed their degree, 12 per cent had some psychiatric illness.

Furneaux (1962) reported that, of 500 students who had completed a university course, 25 per cent said that they had experienced a need for psychological help. Of those who were classified as neurotic introverts, 63 per cent had experienced a need. This again indicates that psychological testing is not justified in selection, but that wider counselling is necessary.

Malleson (1963), suggested that more realistic estimates of the incidence of psychiatric disorder were that between 1 and 2 per cent suffered from severe disorders and a further 10 to 20 per cent visited a health service for help. He makes the important point that minor disorders of the type experienced by 10-20 per cent of students are not really illnesses but more part of the emotional stress of growing up. His figures have been replicated by Still (1966), Lucas et al (1966), Kelsall (1963) and in New Zealand by Ironside (1966).

How many of those failing have experienced psychological problems? Lucas et al (1966) report that one-third of failures had some disorder, but as we have already noted Kelvin et al (1965) reported that two-thirds of first class students had some disorder.

In Scotland, Macklin (1951) at Aberdeen suggested that the university was a factor in causing stress and Kessel found that at Edinburgh women were more likely to experience psychological disturbance than men. Nisbet and Napier (1969) found no evidence of an association between physical or mental health and academic performance.

In summary, it is fair to conclude that poor mental health is not the cause of as much poor performance as would appear to be the case if one considers Dale's work. It seems true that between 10 and 20 per cent of the student population may be expected to experience some form of psychological stress, but that for most of these students it will be of no consequence as a predictor of performance. The studies do demonstrate a need for an adequate counselling service to be readily available.

2.3.8.5 Personality and academic performance: conclusions

There appears to be only one consistent relationship between personality and academic performance: that mildly neurotic introverts tend to perform better than extraverts, and even here, some subgroups of extraverts have performed well (Entwistle et al (1974)). Motivation has also been shown to be a good discriminator between high and low performance. The main limitation of personality measures as predictors of academic performance has been methodological.

There is little evidence that any of the personality inventories used thus far is reliably measuring the phenomenon it sets out to measure. Therefore, the use of such inventories in selection has little justification. The main purpose in understanding personality differences in academic performance will be to assist counselling staff to aid those students 'at risk' of failure to pass. For such an approach to be profitable requires an adequate, trained counselling service, and a feeling among students that there is nothing "unusual" in using this service.

2.3.9 Study Habits

Much of the recent research on academic performance has stemmed from the contention that those students who perform well will study in a different way from those who perform poorly. There have been five stages in the development of measures of study habits as discriminators of academic performance.

The first measure used was the number of hours worked by the student. Thoday (1957) and Flecker (1959) both reported that students who worked longer performed better. However, while it is probably true that those who work longer hours will perform better, it is also possible that they will work less effectively. There will undoubtedly be some students who work for many hours but in such an inefficient way as to be deleterious to their performance. Some studies have, as a result, found weak relationships between hours worked and academic performance. For example, Miller (1970a) cites Harris (1940) as finding only one positive relationship in a number of studies. Malleson (1963) and Cooper and Foy (1969) also failed to find any relationship between hours worked and performance. One study which did find a relationship was that by Entwistle and Percy (1974) who used a grid designed by Entwistle and Entwistle (1970) to aid the students to report their study accurately.

The second stage of the research in Britain into study habits was initiated by the work of Brown and Holtzman (1966) who had developed a comprehensive survey of study habits and attitudes (SSHA). This scale attempted to identify four different facets of study habits (a) work methods; (b) delay avoidance (promptness in completing work); (c) teacher approval; and (d) educational acceptance (the extent to which the student approves of the educational objectives demanded by his teachers and institution). Brown and Holtzman (1955) found correlations of 0.4 with college grade point average. The SSHA has been used in Britain by Cowell and Entwistle (1971) and Dobson (1979). Cowell and Entwistle report correlations between 0.16 and 0.37 for the four subscales with academic performance, but found the subscales to be quite highly intercorrelated and suggest combining (b) and (d) to obtain the best association with performance. Dobson found his strongest relationships between the teacher approval subscale and performance, especially among girl Science students. He argues that many of the results relate more to specific situations than to overall measures of performance and that research should follow this approach.

Lum (1960) found that some combinations of the subscales differentiated between three performance groups of female college students, while Ahmann et al (1958) found the SSHA did not add significantly to the predictive capacity of a group of objective predictors. The results lack consistency, perhaps, for the British studies as a result of the scale being developed for use in America. They suggest that a British scale, developed for the British system, may prove fruitful.

The third stage of the research on study habits was instigated by Hudson (1968) who suggested that students studied in different ways which parallel the cognitive distinction between convergent and divergent thinking. He identified different groups of students whom he called "sylbs" whose study was dictated by the demands of the syllabus and "sylfs" who studied in a more dilettante manner, without constraining themselves too closely to the syllabus. Parlett (1970) developed a scale of syllabus boundness for American students.

Smithers (1973) used a sylbism measure at Bradford. He found sylbism to be positively related to performance especially in the Physical Sciences. Interestingly, in the Social Sciences he found both sylbism and sylfism to be related to performance when interacted with other variables. Sylbism was positively related to motivation while sylfism was negatively related to neuroticism as predictors of success. Entwistle and Wilson (1977) found that sylbism or sylfism entered five of their attainment clusters in 'The Rowntree Project'. High ability sylbs performed very well, generally, but sylfs performed well in the Social Sciences.

The fourth stage of the work on study habits has involved the development of a number of British study habits inventories. Entwistle et al (1974) took as their starting point the work of Eysenck (1972) and Biggs (1970) who argued that neurotic introverts would have efficient study methods. Entwistle et al developed a scale for use with British students but the initial results did not agree with those of Eysenck. Entwistle and Entwistle (1970) and Entwistle and Cowell (1971) reported that stability and introversion were linked to "good" study habits. In the Rowntree Project, Entwistle reports that correlations between this scale and academic performance ranged from 0.18 to 0.29 . They also found a positive relationship between stability and study habits. However, Wilson (1969) found that, although 75 per cent of the unstable introverts with good study habits performed well, so did 79 per cent of the unstable extraverts. He interprets this as a confirmation of Eysenck's (1972) contention that the relationship with performance will depend on the way in which the extraversion is exhibited. Wilson concludes that:

> "Only where extraversion leads directly to poor study methods will the predicted low degree class arise".

Another often used study habits scale was developed by a committee representing Scottish universities and is based on that used by Jones (1972) and McPherson (1973). McPherson found little difference in the way SCE and GCE qualified students at Edinburgh studied despite large differences in the way they had studied at school. This scale has also been used by Main at Strathclyde, who has administered it to every entrant to Strathclyde since 1976. He has found that efficient study methods are indicative of successful performance, but his results are as yet unpublished.

Inventories have been used in America by Astin (1975) who found that those who were more conscientious in their studies were more likely to complete a degree. His only unusual finding was that some high performers reported they "made careless mistakes a lot". He interprets this as being due to the fact that it is only the better students who are in a position to make careless mistakes although this seems rather idealistic. Panatages and Creedon cite Demitroff (1974) who found that drop-outs were more likely to describe their study habits as poor or below average, although it seems likely that this could be a rationalisation on the part of the studentsthemselves. Efficient study habits have also been positively related to performance from inventories used in Australasia (eg Small (1966), Sanders (1961) and Pond (1964)).

The fifth development has not been widely used. It is the study of the standard of students' study habits. One good study by Wilson (1968) examined nine sets of lecture notes for 21 students. He found that students who took full notes did so whatever the lecturer, with similar results for those who took sparse notes. He found a correlation of 0.6 between quantity of notes and degree performance. The size of the sample obviously prohibits any general conclusions but there would appear to be scope for fuller,more extensive studies.

In summary, the evidence from the literature suggests that study habits are associated with academic performance. However, the level of association is likely to be low if only a single scale is used, for two reasons. Firstly, there are problems of the validity of the scale. Many students may identify the "positive" study habits and subconsciously feel that this is the way that they themselves study, thus leading to unreliable scales. Secondly, within any system there are the "exceptions that prove the rule" - students who perform excellently apparently with a minimum of preparation.

Overcoming these problems is not easy. One method is to devise better scales and develop them on large samples across different subjects and institutions to investigate possible inter-subject differences in study habits. It is to be hoped that the current national survey being administered at Lancaster University will help in this respect. Another possibility is the use of in-depth interviews to examine the complex interactions between different types of studying and such factors as motivation and personality. The practical drawback of this method is that it would be extremely time-consuming, and if it was offered only to those 'at risk', say, it would leave itself open to bias. In practice, it is essential that efforts are made to ensure that entrants are aware of the various study methods, their advantages and their disadvantages for the study of the student's chosen subjects. Such a process could start during the student's last year at school and be continued at the university. Once more, for such an approach to be successful, there would need to be adequate, available counselling for those who required assistance together with continued monitoring of the methods most favoured.

2.4 SUMMARY AND CONCLUSIONS

The discussion of those variables which have been used as predictors of academic performance has demonstrated that some are more relevant than others. School qualifications have been shown to be the best predictors, especially of first year performance, at university, and social class appears to be related, although the direction of the association is somewhat unclear. Methodological problems are the major limitations of the descriptors, although it seems clear that there are definite associations.

Having highlighted many of the difficulties which arise in attempting to predict academic performance, we should now consider the possible alternatives.

One approach (eg Humphreys (1968)) is to conclude that prediction is impossible and to recommend that failures should be allowed to stay in the university so long as they are making minimal progress towards a degree. This approach is supported by Kendall (1964a,b) who reports that a large proportion of those who left University College London went on to complete some kind of degree elsewhere. However, a student's performance at a university may be related to their not "fitting-in" with some aspect of the university. Therefore, staying on may be deleterious in the long run for the student might study more efficiently at another institution.

A second approach is to admit that very accurate prediction is not possible, but that, through experience, we may identify the minimum qualifications with which a student might be expected to pursue a successful degree course. Then we may predict those who are likely to experience most difficulty and take steps to help them to overcome the transition from school to university, and to overcome any gaps which may exist in their knowledge of the subjects they will study at university.

Therefore the structure of this study will concentrate on a scientific analysis of the prediction of performance on the basis of school qualifications, which we have seen are likely to be the best predictors. The study will then attempt to identify some of the differences between those groups who perform well and those who perform poorly, so as to suggest methods to help students to successfully complete a degree course. To quote Nisbet and Welsh (1976):

> "The solution does not lie in refining the instruments of prediction in an absurd hope of ultimately finding a technique for classifying our students in exactly the same order of merit throughout the course. The attempt to devise a

method of perfect separation of good students and bad students suggests the calculation of the orbit of a satellite: if one knows the student's velocity, direction and density, his path is assured to be predictable. This would be true only if the student were inert, and the university through which he passes like outer space, vacant and sterile".

CHAPTER 3

THE METHODOLOGY OF ACADEMIC PREDICTION

The review of the variables associated with performance at university indicated a number of flaws in the methodology of some studies. These flaws will account for some of the unexplained variations in performance commonly encountered in studies which attempt to predict academic performance.

In this chapter we will investigate some of the techniques used to predict academic performance. There will be two sections: the first deals with the design of the study and the second with the analysis.

3.1 THE DESIGN OF STUDIES TO PREDICT ACADEMIC PERFORMANCE

While many of the necessary stages of the design of a study are common to any social research project, for example pilot studies, questionnaire design, there are a number of specific considerations in a study of academic performance, whose omission would cast serious doubts on any conclusions.

Initially, let us consider the definition of the population to be studied and the size of the sample. It is at this stage that a number of studies may be criticised. The population under study has in some cases been restricted to one department in one university in one year. Gray and Satterley (1976) argue, in a school context, that such studies represent only one observation as the unit of sampling is the classroom rather than the individual. Although this argument may not be completely extrapolated to our position, there can be little doubt that the generalisability of results based on one year or one department is extremely limited. Some of the higher correlations between school and university performance have been reported in such studies, eg Austwick (1960), Williams (1950), but the significance of these results is often not much better than large surveys which report smaller correlations.

A second major drawback of studies such as these concerns the reproducibility of the results over time. For example, the entrance qualifications of those students who entered the Faculty of Arts at St Andrews in October 1971 but failed to complete a degree were, as a group, higher than those in other years. It is obvious that estimates of parameters predicting failure from academic qualifications based solely on this year would be proved fallacious in most other years.

Therefore it is essential, if it is at all possible, that scientific studies of academic prediction include the potential for some form of replication with results from other years. Replication may be obtained by considering similar departments and courses in other universities or through using different years. The former approach is susceptible to error resulting from different standards and courses in different universities, while the latter does not permit generalisability outwith the university within which the study takes place. It is essential then to define carefully the population and the scope of the study. Examples of studies based on one year are those by Austwick (1960), Williams (1950), Bagg (1968), Kapur (1971) and McPherson (1973). Among the few which consider the performance of students over more than one year are those by Nisbet and Welsh (1966, 1973), Himmelweit (1963) and Craig and Duff (1961).

Even after the definition of the population, there are a number of sampling problems facing the intending researcher. For example, if one wishes to conduct a study in a number of universities it may prove impossible to include some universities in the sample. This is because, for political reasons, many universities are not prepared to cooperate in studies which consider academic performance in their institution or to release important information such as the number of failures in any year. For example, in Scotland, only the Universities of St Andrews and Edinburgh regularly publish details of the performance of their entrants. The prime reason given by those who choose not to disclose their figures is that the results of studies of academic performance, and figures relating to failure, are open to misinterpretation. An example of such a misinterpretation was provided at St Andrews in 1974 (Failure Rates Report (1974)) which argued that the failure rates in certain first year classes was unduly high. Careful examination of the failures revealed that much of this failure could be attributed to students from higher years who were required to repeat a subject. We will argue in Chapter 8 that carefully defined, freely available figures regarding failure rates should be the norm rather than the exception.

A second sampling problem is that of non-response. Many samples are self-selected, and take place in the researcher's own department, eg Bagg (1968), Williams (1950). The problem is illustrated by Wilson (1969) who achieved excellent response when he was permitted to use class time to distribute an attitude questionnaire, but found that only 53 of 115 Geography students responded to a request to undertake an intelligence test in their own time. The problem is not so much one of a poor response rate, but that those who do respond may differ on some important criterion from those who do not (eg the non-respondents may contain an unduly high proportion of low performers). For example, Entwistle and Wilson (1977) in "The Rowntree Project" found that non-respondents had an average 'A' level score one grade lower than those who did reply.

The decisions regarding the population under study and the sample size are accompanied by decisions regarding the choice of a suitable research design. Three main approaches have been common: retrospective studies, longitudinal studies and case studies. Let us consider retrospective studies initially. Under this approach one identifies, for example, those students who have performed well and those poorly or those who have performed above expectations. One then attempts to identify variables which discriminate between those groups. Lavin (1965) identifies a number of factors which must be considered when undertaking retrospective studies. Firstly there may be difficulty in defining over and under achievers. Table 3:1 is reproduced from

Table 3:1: Over and under achievement

		University Performance		
		Low	Medium	High
Qualification	High	Pronounced under achievement	Under achievement	Performance equal to capacity
	Medium	Under achievement	Performance equal to capacity	Over achievement
	Low	Performance equal to capacity	Over achievement	Pronounced over achievement

Lavin (1965) and demonstrates that it is impossible for those who enter with very high qualifications to over achieve. Secondly, one needs to make allowance for regression effects which may affect the prediction of performance. By this we mean that extreme scores at school may be subject to some error which is not present in assessment of university performance and vice versa.

Retrospective studies are also very prone to a number of errors. Firstly, poor memory may bias results; e.g. we noted on P.63 that head-teachers were asked to rate the potential of students who, in some cases, they last taught eighteen months previously. Secondly, a person's response to a question regarding some event may be biased by another event that has occurred since, e.g. students taking an ordinary degree as a result of poor examination performance may report incorrectly that an ordinary was their original intention.

While these drawbacks to the use of retrospective studies are very important, there is often little alternative, for reasons both of cost and time, to their use and much of the literature is based on such studies. It is essential that care is taken to allow for these potential sources of error if circumstances dictate that a retrospective approach is necessary.

The research designs most usually suggested in preference to a retrospective approach are longitudinal studies. An optimum approach is to consider longitudinal studies of cohorts of students in different years. The use of cohorts eliminates sampling errors and allows for increased confidence regarding any conclusions. However, non-response may be a problem if data is required regarding attitudes and opinions of courses. We will argue in Chapter 8 that universities should maintain demographic records of the flows of each cohort through the university.

The third approach is the use of case studies. Here, the generalisability of the study is extremely limited, the use of in-depth interviews, as is common in case studies, may help us to interpret results found in larger questionnaire type studies, and also to improve our understanding of such concepts as motivation and study habits. An example of such an approach is by Thompson (1976).

3.3 THE ANALYSIS OF STUDIES TO PREDICT ACADEMIC PERFORMANCE

3.3.1 Correlation

For many years the analysis of studies of the prediction of academic performance simply involved the definition of a criterion of academic performance, and of the variables which were to be used as predictors followed by calculation of relevant correlation coefficients. As we have seen in Chapter 2, the variable most associated with university performance is school performance, but the correlations between school and university performance have generally been found to be small.

There are three main reasons which contribute to these poor levels of correlation. Firstly, the use of correlation coefficients assumes that there is a linear relationship between the variables under consideration. For example, with respect to academic ability, it assumes that there is only one route to academic success - that the poorly qualified will perform poorly and the highly qualified will perform very well. There are a number of arguments against this assumption. McLelland (1953) has argued that academic ability may be a threshold variable. That is to say that above a certain level of ability all students will experience little difficulty in succeeding at university[1]. Secondly, with regard to anxiety, Eysenck has postulated the Yerkes Dodson Law which would suggest that there is a non-linear relationship between anxiety and academic performance with both too little and too much anxiety being detrimental to academic performance. Any error in either of the two variables being correlated will result in a reduction of the correlation between the two variables. There are a number of sources of such errors in school and university performance. For example, there is some doubt as to the reliability of examination

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1 Similar results have also been suggested by Nisbet and Welsh (1966, 1973) and Wilson (1969).

marking. A number of authors, eg Cox (1967), Murphy (1978), have demonstrated that there is some variability between markers, especially in some of the more "subjective" examinations. At university there is certain to be some subjectivity in the awarding of different degrees in different years, and if the best data available are of grades then the resulting correlation will be reduced. There are also likely to be differences in the academic qualities expected of students at school and at university. For example, McPherson and Neave (1976) report that the teaching and learning methods experienced by a sample of Scottish students at school differed from those they experienced at university. Thus it is possible that students who performed only moderately at school may find the transition to learning at university smoother than some better qualified contemporaries and out-perform this group.

Thirdly, there must be some doubt regarding the validity of the criterion of performance. In general performance either in first year or in the final degree examinations has been used. Good performance may reflect a thorough knowledge of the subject or luck that certain questions appeared in the examination. Furthermore, many studies assume that performance in different subjects is directly comparable, and within subjects is comparable in different years. Such assumptions may well be erroneous. For example, Kelly (1977) investigated the comparability of results awarded in different SCE 'O' and 'H' grade examinations between 1969 and 1975. She compared the grade awarded to a student in a particular subject with the average achieved in all subjects sat by the student, and reports that the "hardest" subjects tended to be taken by the most able students. In general, languages were found to be the hardest subjects, followed by science, social science and, finally, vocational subjects. These results agree with those of Nuttall et al(1974) who studied the GCE system.

A fourth contributory factor to the poor correlation between school and university performance is provided by the fact that only those who perform well in their school examinations go on to university. It follows that poorly qualified university entrants will not be representative of those who performed poorly in school examinations. They will be students who have demonstrated some academic promise, but will not necessarily consist of a group of students all of whom have performed better at school than any school student who does not enter a university. Hence it is to be expected that there will be some difference between the rank performance of students at school and university.

A fifth, very important factor concerns the weights assigned to the various school and university grades. It is rare for studies to have access to the actual percentages gained by each student in their school or final degree examinations and most studies base their analysis on the grades awarded to each student. To calculate product moment correlations it is necessary to assign weights to these grades, a problem which most studies overcome by assigning linear weights to each grade. For example, McPherson (1973) and Kapur (1971) assign weights A = 1, B = 2, C = 3 to SCE Higher grades. Kapur (1971) justifies such a system on the grounds that it is used by admissions officers in one faculty at Edinburgh University, the university in which his study is based. Similarly, many studies, eg Entwistle and Wilson (1977), Freeman (1970), assign weights A = 5, B = 4, C = 3, D = 2, E = 1 to GCE 'A' level grades. Gill (1971) reports that, although this scale is used by UCCA, his analyses suggest that it

> "... results in a slight lowering of the value of a B grade and the raising of the value of a D grade".

In fact UCCA recognise this and note (UCCA 1975) that this scale is used only as a "convenient indication of the overall A-level qualifications of candidates who have taken the GCE examination". Gill also imposes a non-linear scale on SCE Highers qualifications and justifies it thus:

> "In Highers a 'B' and a 'C' both cover an equal range but an 'A' covers a much larger and higher range".

While the results of this thesis will support this view, Gill's supposition appears somewhat subjective. His proposal of a non-linear scoring system is, however, an exception in studies of academic performance. Only four other studies suggest a non-linear scoring system for school or university grades. Nisbet (1974) suggests the use of stanines for assigning weights to school grades. These are used by Dobson (1979). Secondly, Astin (1971) suggests that, in America, the mean college GPA increases linearly until a B grade, but that the weights assigned to the upper grades should be increased. He suggests the following scale:

Table 3:2: Scoring system due to Astin (1971)

	Grade							
	D	C	C+	B−	B	B+	A−	A−/A+
Old scale:	1	2	3	4	5	6	7	8
New scale:	1	2	3	4	5	6.5	8	9.5

However, he offers no analytical justification for this scale. Finally, Lewis (1970) reports on the use of canonical correlations to investigate the relationships between different degree and school performance grades. He reports that those students with two 'A' levels with a 'B' average perform, as a group, similarly to those students with three 'A' levels with a 'C' average.

To summarise the evidence on school grades, it appears that extra weight should be given to an 'A' grade, both for GCE examinations and for SCE examinations, but there is no evidence to suggest how much extra weight should be given to an 'A' grade.

With respect to university performance, many studies adopt a linear scale for final degree categories. For example, Freeman (1970) uses: First = 6; 2(i) = 5; 2(ii) = 4; Third = 3; Pass = 2; Fail = 1. Gill (1971) uses a non-linear scale thus: First = 10; 2(i) = 8; 2(ii) = 7; Undivided Second = 7.5; Third = 6; Ordinary = 5; Fail after three years = 3; Fail after two years = 2; Fail after one year = 1. His reasons for stretching the scale at the upper end are that examiners "claim to be able to distinguish clearly between first class degrees and second class ones". These reasons are clearly subjective and offer no grounds for replication. The only study which attempted to assign weights on the basis of a statistical analysis was that of Barnett and Lewis (1963). They used canonical correlations and report that a linear scale was justified with the exception of one group where a 2(i) was awarded a greater weight than a first.

It is essential, then, that there should be a statistical justification for any weights which are assigned to grades for use in correlation or regression analyses.

In summary, we should only use correlation analyses if we are sure of the assumptions we are making, of their relevance and of their potential flaws in correctly assessing the level of association between university performance and the relevant predictor.

3.3.2 Regression

The second most prevalent technique in the prediction of academic performance has been linear regression. Many of the criticisms of correlational analyses are appropriate here, especially the lack of consideration of a quantitative scoring system. Furthermore, there has seldom been any considerations ofthe basic assumptions required for linear regression.

Another drawback is that linear regression coefficients tend to predict values of the dependent variables close to the middle of the scale. An example is provided by a regression of university performance on school qualifications among those students who entered St Andrews in October 1971 and took a Mathematics degree. The independent variables were the number of A grades, B grades and C grades obtained by each SCE student in their Higher examinations. The value of $\hat{\alpha}$, the coefficient of the number of A grades, was 1.4 . Hence a student with five A grades could be expected to have a degree score of 7, which corresponded to a lower second. The data suggested that students with five 'A' grades might be expected to perform a little better. An improvement could possibly be made by introducing polynomial terms into the regression. Unfortunately analyses using such an approach have not been reported in the literature. An alternative approach is possible to consider the predicted ranks of the sample and compare them with the actual results gained by each student.

As with correlation, it is essential to clarify the relevant assumptions before embarking on an analysis.

3.3.3 Multivariate Techniques to Explain Performance

A number of multivariate approaches have been used to help to explain different levels of performance. Many of these have been used as "data dredging" tools to examine large sets of data for these combinations of variables which are most associated with high or low performance. In this section we describe three techniques used to identify descriptors of university performance.

Cluster analysis has been used by Entwistle and Brennan (1971) to identify groups of students who performed differently. They used the 'K-means' clustering algorithm (Wishart, 1969) on data consisting of the academic performance, study-habits, personality and personal values of a sample of 875 students from three universities in the North of England.

Using the 'K-means' algorithm, they report that 12 clusters offered the most suitable solution and describe the types of students in the various clusters (see Chapter 2). Such an approach can be very useful, especially for descriptive purposes, although there may be difficulties in deciding on the most suitable number of clusters.

Entwistle and Wilson (1977) report the use of AID (the Automatic Interaction Detector) (Sonquist and Morgan, 1963) to explain variations in performance, and also of factor analysis. These last three approaches are useful only with large data sets and under the correct assumptions. As long as these criteria are fulfilled they provide valuable exploratory tools. However, as with other techniques such as discriminant analysis and association analysis (Freeman, 1970), their main use will be in the explanation of academic performance rather than its prediction.

In summary, the main requirements of a predictive model are that both the criterion of performance and the predictors are carefully defined and that any assumptions required of the techniques proposed are shown to be applicable.

CHAPTER 4

A SCORING SYSTEM FOR SCHOOL AND UNIVERSITY PERFORMANCE

We may now consider the first of the problems introduced in Chapter 1: that of assigning ordinal scores to both university degree classifications and school examination grades so as to optimise the prediction of university performance from an additive score based on the students' school qualifications.

In Chapter 2 we concluded that school qualifications have been the best predictors of subsequent university performance, but that, in general, this relationship has not been very strong. In this chapter, we will investigate this relationship with particular reference to St Andrews, where a thorough scoring system will require that we may compare directly grades awarded to students in SCE Highers examinations with those in GCE 'A' level examinations. We will devise such a scoring system in this chapter, while in Chapter 5 we will discuss the adequacy of the system and evaluate the optimum prediction of university performance at St Andrews on the basis of the scoring system.

4.1 AN APPROACH USING RANK CORRELATIONS

We wish to adopt a method of optimally assigning weights to SCE and GCE grades so as to obtain the closest association with university performance. Associated with this problem is that of assigning the optimal rank ordering to the various final degree categories. For example, what is the optimum rank of an ordinary degree in comparison with a third?

Figure 4:1 depicts the "perfect" situation where the rank correlation between university performance and a score based on the student's performance in the school examinations is one.

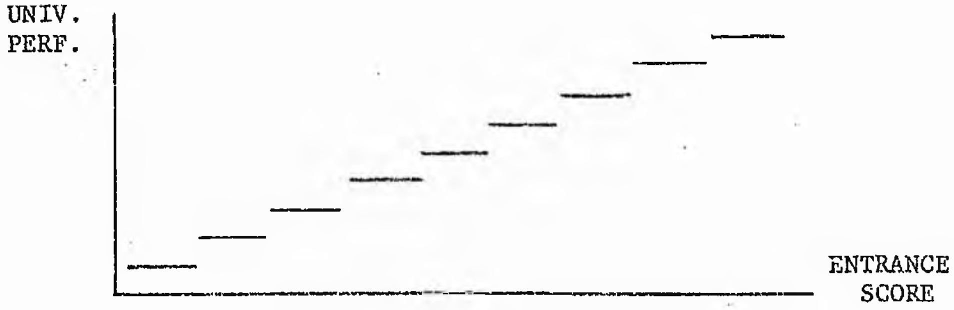


Figure 4:1: Maximum rank correlation between school score and university performance

Let us assume that we may assign weights to the grades obtained by each student in their school examinations and amalgamate them to form an overall entrance score for each student. For example, for SCE qualifications, let α,β,γ be the weights assigned respectively to an A, a B and a C (in the linear case these weights would be $\alpha = 3$, $\beta = 2$, $\gamma = 1$). The school score would then be $\alpha n_A + \beta n_B + \gamma n_C$ where n_A, n_B, n_C are respectively the numbers of A grades, B grades and C grades gained by each student.

We may formulate the problem as one of finding the α,β,γ which maximise the rank correlation between school and university performance. This initially appears to be a problem of maximising partial correlations, ie we want to find the α which maximises the partial rank correlation between university performance and the number of A's gained, holding all other variables constant. We may interpret α as the worth, in terms of improved university performance, of gaining an extra 'A' grade as opposed to a 'B' or 'C'

However, this is not the case. When students are accepted by a university, they are accepted on the basis of an overall academic qualification, and when they arrive they bring with them an overall academic expertise, not, in general, a group of marginals. Hence, we should be trying to maximise the overall rank correlation.

To maximise the rank correlation it is necessary to investigate the way in which changes in α alter the rank of the school performance criterion and thus affect the rank correlation. Initially, let us assume that $\beta = 1$ and $\gamma = 1$ and consider the rank correlation between

Y_i : university performance

and $W_{\alpha_i} = \alpha n_{A_i} + K_i$ where $K_i = n_{B_i} + n_{C_i}$

If we assume that we may order the Y_i (which at this stage we are unable to do with certainty) then there will be a change in the rank correlation whenever the rank of W_α changes. There will be such a change whenever

$$\alpha n_{A_i} + K_i = \alpha n_{A_j} + K_j$$

i.e. when $\alpha = \dfrac{K_j - K_i}{n_{A_i} - n_{A_j}}$

For an optimum solution we must identify the α for which the rank of W_α is identical to that of Y. However, for each group of n combinations of grades there will be $\frac{n(n-1)}{2}$ such α values. Some of these will be negative, and some will duplicate but even for comparatively small values of n there are likely to be a large number of different α's. As an example, Table 4:1 illustrates a case where n=8.

In order to identify the most suitable α we must satisfy two conditions. Firstly, certain α's must produce identical rankings of school performance and therefore identical rank correlations. Secondly, it must be possible to identify such values of α easily so as to reduce the number of α's which need to be calculated to a computationally practicable size.

We consider two approaches to this problem. Firstly, we could eliminate all the negative α's as it is fair intuitively to assume that gaining an 'A' grade in a school subject will benefit a university career.

Table 4:1: An example to illustrate changes in the rank of $^nA_i + k_i$ for changes of α.

^nA_i	1	2	3	4	5	6	7	8
k_i	5	4	2	8	6	3	7	1

The rank of $\alpha n_{A_i} + k_i$ changes at α = -6; -4; -2; -2; -5/4; -1; -2/3; -3/5; -1/2; -1/3; -1/3; -1/4; 1/5; 1/4; 1/3; 2/5; 1/2; 4/7; 1; 1; 3/2; 5/3; 7/4; 2; 2; 5/2; 3; 6.

α								
∞	1	2	3	4	5	6	7	8
6	1	2	3	4	5	6	7=	7=
3	1	2	3	4	5=	5=	8	7
5/2	1	2	3	4=	6	4=	8	7
2	1	2=	2=	5=	5=	4	8	7
7/4	1	3	2	6=	5	4	8	6=
5/3	1	3	2	7	5=	4	8	5=
3/2	1=	3	1=	7	6	4	8	5
1	2=	2=	1	7	6	4=	8	4=
4/7	3=	2	1	7	6	5	8	3=
1/2	4	2=	1	7	6	5	8	2=
2/5	4=	3	1	7	6	4=	8	2
1/3	5	3	1	7=	6	4	7=	2
1/4	5	3=	1	8	6	3=	7	2
1/5	5	4	1=	8	6	3	7	1=
0	5	4	2	8	6	3	7	1

From (4:1) we see that a negative α will occur whenever $n_{A_j} > n_{A_i}$ and $K_j > K_i$ (for all $i,j = 1,\ldots,n$). However, there is no pattern by which one may deduce which α values will be negative other than by an inspection of all the $\frac{n(n-1)}{2}$ α's. Therefore this first approach was rejected.

The second approach is to look for a pattern by which we may identify the values of α which give rise to identical orderings of W_α. Setting $n=4$, $\beta=1$, $\gamma=1$ and $k_i = n_{B_i} + n_{C_i}$ let us consider

$$Z_{\alpha_i} = R(\alpha n_{A_i} + K_i) \text{ where } R(\ ) \text{ denotes the rank of } \{\ \}.$$

$$y = r_1, r_2, r_3, r_4$$

We assume initially that the correct ordering of y is known,and therefore require the α which sets the rank of Z_α identical to that of y. Denoting the rank correlation between y and Z_α as $\tau(yZ_\alpha)$ we see that $\tau(yZ_\alpha)$ ranges from $-\tau(yn_A)$ as $\alpha \to -\infty$ through $\tau(yK)$ as $\alpha = o$ to $\tau(yn_A)$ as $\alpha \to \infty$. The greatest number of changes a particular rank can make is, of course, observable immediately as is the number for a particular sequence. For example, for n=4, the greatest number of changes made by a particular rank is 3 {e.g. y = {1,2,3,4} , Z_α = {2,3,4,1}} and the distribution of the number of moves to place each permutation in monotonic order is displayed in Table 4:2

Table 4:2: Distribution of number of changes between neighbours required to achieve perfect association between university performance ranks and school qualification ranks

Moves required	Sequence
0	{1234}
1	{1324} {1243} {2134}
2	{2314} {2143} {3124} {1342} {1423}
3	{3214} {2341} {2413} {3214} {3142} {1432} {4123}
4	{3241} {2431} {4213} {3412} {4132}
5	{3421} {4231} {4312}
6	{4321}

However, this knowledge does not help us to identify a structure by which we may limit the number of α's to be considered, nor, more importantly, does this technique define α uniquely. For example, consider

$$\begin{array}{l} n_{A_i} = 2\ 3\ 1\ 4 \\ K_i = 3\ 1\ 2\ 4 \end{array} \Rightarrow Z_\alpha = 3\ 2\ 1\ 4$$

To change 4 and 1 in Z_α we calculate $\alpha = \frac{2-4}{4-1} = -2/3$. This only tells us that we change 4 and 1 if $\alpha \leq -2/3$. It does not define a unique value for α.

In summary it may take up to $n(n-1)/2$ interchanges of neighbours to arrive at a given permutation of ranks. As n increases there appears to be no structural way of limiting analytically the number of α's that need to be considered. Therefore, an empirical approach was adopted. The aim was to calculate the optimum weights of α, β given

$\gamma = 1$ using the following algorithm.

1. Find $\bar{\alpha}$ to maximise $RC(y_i, \alpha n_{A_i} + k_i)$ given $\beta = 1$.
2. Find $\bar{\beta}$ to maximise $RC(y_i, \bar{\alpha} n_{A_i} + \beta n_{B_i} + n_{C_i})$.
3. Find β^* to maximise $RC(y_i, \beta n_{B_i} + u_i)$ where $u_i = n_{A_i} + n_{C_i}$.
4. Find α^* to maximise $RC(y_i, \beta^* n_{B_i} + \alpha n_{A_i} + n_{C_i})$.
5. Choose either $(\bar{\alpha}, \bar{\beta})$ or (α^*, β^*) so as to maximise RC.

There are three drawbacks to the use of this algorithm. Firstly, it requires the computation of a large number of α's and β's, and for GCE students of α's, β's, γ's and δ's. Secondly, the solution may not be a global optimum. The optimum rank correlation need not necessarily include the optimum α or the optimum β. Finally, there are likely to be a large number of ties in the data as the number of subjects studied at school is unlikely to exceed seven for SCE Highers or four for GCE 'A' levels.

The algorithm was programmed but proved to be computationally infeasible as it required the calculation of a prohibitively large number of rank correlations for a sample of 70 entrants to the Mathematical Institute at St Andrews. Therefore, as there was no apparent method of minimising the number of calculations, it was necessary to adopt a new approach.

4.1.1 An Approximation to the Product Moment Correlation

The new approach was to make use of a result derived by Greiner (1909) from which we may state that

$$E(t) = \frac{2}{\pi} \sin^{-1} \rho \qquad (4.2)$$

where t is Kendall's τ coefficient of rank correlation and ρ is the product moment correlation under the usual assumptions. Then, if it is fair to assume that school and university performance are bivariately normally distributed we may attempt to find an expression for α, β, γ in ρ that maximises equation 4:2.

Let us consider the product moment correlation if y_i is university performance and $\alpha n_{A_i}, k_i$ are defined as before. Then

$$\rho\,(y, \alpha n_A + k) = \frac{\text{cov}(y, \alpha n_A + k)}{\sqrt{\text{var}(y)\,\text{var}(\alpha n_A + k)}}$$

$$= \frac{\alpha\,\text{cov}\,(y n_A) + \text{cov}(yk)}{\sqrt{\text{var}(y)\,[\alpha^2 \text{var}(n_A) + \text{var}\,k + 2\alpha\,\text{cov}(n_A k)]}}.$$

Solving $\frac{\partial \rho}{\partial \alpha} = 0$, we find ρ is maximised when

$$\alpha = \frac{Cyk\; Cn_A k\; Vy - Cy n_A\, Vy\, V_k}{(Cn_A k\; Vy\; Cyn_A \;\; - Cyk\; Vn_A\, Vy)} .. \quad \text{where } Cn_A k = \text{cov}(n_A K) \qquad (4.3)$$

Similar results are found for β, γ. The results were programmed according to the following algorithm.

1. Find $\bar{\alpha}$ to maximise $\rho(y, \alpha_{n_{A_i}} + k)$.
2. Find $\bar{\beta}$ to maximise $\rho(y, \beta_{n_{B_i}} + \bar{\alpha} n_{A_i} + n_{C_i})$.
3. Find $\bar{\gamma}$ to maximise $\rho(y, \gamma_{n_{C_i}} + \bar{\beta} n_{B_i} + \bar{\alpha} n_{A_i})$ ....(4.4)
4. Return to (1) and substitute the new values of $\bar{\beta}, \bar{\gamma}$ into the equations above and continue until the results converge.

For the GCE data there are an extra two parameters to be considered but the theory is the same. When the results were calculated for all entrants to St Andrews in October 1971 and October 1972, there were a number of major inconsistencies in the results.

Firstly, the SCE data converged fairly quickly, but the results were different if the starting point was β rather than α.

The results for four different starting points are displayed in Table 4:3. The ratios are similar, but there can be no certainty which result is the most appropriate.

Table 4:3: Values of α,β,γ for four iterations of (4.4) from four starting points

Order		Iteration 1	Iteration 2	Iteration 3	Iteration 4
	α	1.51	1.60	1.60	1.60
α:β:γ	β	1.22	1.22	1.22	1.22
	γ	0.71	0.70	0.70	0.70
	α	1.00	1.01	1.01	1.00
β:γ:α	β	0.77	0.77	0.77	0.77
	γ	0.44	0.44	0.44	0.44
	α	2.13	2.22	2.18	2.15
β:α:γ	β	0.77	1.21	1.50	1.62
	γ	-0.41	0.32	0.78	0.92
	α	0.99	0.99	0.99	0.99
γ:α:β	β	0.75	0.75	0.75	0.75
	γ	0.41	0.43	0.43	0.43

Secondly, the data for GCE students did not converge for any starting point. The values of α,β,γ,δ and ε became progressively more negative in an unstructured manner.

In order to investigate the variability in the results a number of alternative starting points were considered, for example, for GCE grades setting β=0, γ=0, δ=0 and ε=0 initially. Various starting orders for the grades were also tried as in Table 4:3 but at no time did any consistent results emerge.

The reasons for these inconsistencies are not apparent and, as there is also some doubt about the relevance of a direct comparison of the weights assigned to SCE and to GCE grades, it was decided to leave this method of adopting a scoring system and attempt a new approach as described in the next section.

4.2 SERIATION METHODS

We have already stated the two main purposes for requiring scales for school and university performance. Firstly, we wish to apply a quantitative scale to academic performance for prediction purposes. Secondly, we want to make certain decisions regarding the rank ordering of, for example, an undivided second in comparison to a lower or upper second, or two 'B' grades in contrast with an 'A' and a 'C'. It is to this second purpose that this section is addressed.

4.2.1 Sibson's Method

We may formulate the problem as one of placing a set of university degree classes (y_j; $j = 1, \ldots, n$) in a sequential order on the basis of a set of observations (x_{ij}; $i = 1, \ldots, p$, $j = 1, \ldots, n$) on the school qualifications of those in each degree class. This sort of problem is analogous to one which has been investigated in a number of archaeological studies, where, for example, one wishes to place a set of artefacts in order of age on the basis of a number of observations on them. An extensive range of papers on the subject is found in Hodson et al (1971).

The first seriation method used here is based on an algorithm by Sibson (1971). It attempts to rank the y_j's on the basis of a matrix of dissimilarities $d(\underline{x}_i, \underline{x}_k)$ [$i = 1, \ldots, n$; $k = 1, \ldots, n$] between the observations. Three conditions are placed on the dissimilarity coefficients (i) $d(\underline{x}_i, \underline{x}_i) = 0$, (ii) $d(\underline{x}_i, \underline{x}_k) = d(\underline{x}_k, \underline{x}_i)$ and

(iii) $d(x_i x_k) + d(x_k x_\ell) \geq d(x_i x_\ell)$.

Consider the situation where $n = 3$, $p = 1$ (ie we have only one factor influencing the dissimilarities and the ordering {A,B,C}, say, is the correct ordering with respect to this factor), then we would expect to find that $d\{AC\} \geq \max(d(AB), d(BC))$. If this were not true, we would doubt that {ABC} was always the true ordering. For larger values of p and n, it will be possible to construct more inequalities of the above form. The algorithm used here attempts to find the ordering of the y_j's which minimises the number of the above inequalities that are broken.

To illustrate this more fully, if there are n objects influencing the order of the y_j's, to consider all possible orderings would require the calculation of $n!/2$ $\lambda^{(d,a)}$'s where $\lambda^{(d,a)}$ is the number of the above triplets for which there is a contradiction when the ordering is $a = [a_1,\ldots,a_n]$. The calculation of one λ involves the consideration of $\binom{n}{3} = O(n^3)$ inequalities and therefore a whole search involves $O(n^3 n!)$ which is not computationally feasible.

A number of methods have been devised to reduce the number of calculations involved. The ones on which the method used in this analysis is based involve starting with a random ordering and trying to improve this ordering using a limited set of "permutation" searches thus:

1. RELOCATE: a single object is picked up and placed in a gap between two other objects
2. TRANSPOSE: interchange the position of two objects in the sequence
3. REVERSAL: reverse the order of a section of the sequence.

The methods use these operations in various sequences until there is no further improvement in the reduction of the number of contradictory inequalities. A restriction is that to search for a certain global optimum may be computationally infeasible, but to search for too short a time may lead to one arriving at local, non-global optima. Therefore, it is necessary to compromise. This method uses only relocations. The algorithm is:

1. If we assume $Y = y_1 \ldots y_n$ and $\lambda(d,Y)$ is known, we can calculate $\lambda(d,Y^*)$ for $Y^* = y_1 \ldots y_{i-1} y_{i+1} y_i y_{i+2} \ldots y_n$ in only $O(n)$ steps, since only $O(n)$ "triples" are involved in i jumping over i + 1 (i = 1...n).
2. Calculate λ for all sequences available from Y by relocating y_i in $O(n^2)$ steps [as opposed to $O(n^4)$] by moving i to the left one step at a time and then to the right one step at a time, recalculating λ after each step.

Hence the whole process has taken $O(n^3)$ steps which it is certainly feasible to compute.

4.2.2 Dissimilarity Coefficients

The algorithm described above requires that we calculate a dissimilarity coefficient to differentiate between the groups to be ordered.

The data to be used in this analysis comprise the proportions of students in the various degree and school qualification categories (see Table 4:4). We must choose a dissimilarity coefficient which differentiates satisfactorily between groups of proportions. Cormack (1971) describes a number of dissimilarity coefficients, but not all of them are suitable in this situation and none is uniquely ideal.

Therefore it was decided to use what might appear to be a somewhat arbitrary procedure, but is in effect a fairly reliable method. We choose a number of different coefficients and then, if the results from each coefficient are similar conclude that the results are, in general, reliable.

Four measures of dissimilarity were chosen: (a) Euclidean Distance: $d_{ij} = \{\sum_{k=1}^{p}(x_{ik}-x_{jk})^2\}^{1/2}$. This is a very commonly used metric, although it is sometimes criticized for giving too much weight to outlying observations. This may often be overcome by scaling the variables, but scaling is not used here. (b) City Block (Absolute Distance) Metric: $d_{ij} = \sum_{k=1}^{p}|x_{ik}-x_{jk}|$. This is described by Carmichael and Sneath (1969). Its rationale is that when two entities are specified by two variables whose scale units are of equal value, they should have the same distance whether (a) they are two units apart on each variable or (b) they are one unit apart on one variable and three units apart on the other. This can be demonstrated by considering distance in an American city (Figure 4:2) where we require that distance I is the same as distance II.

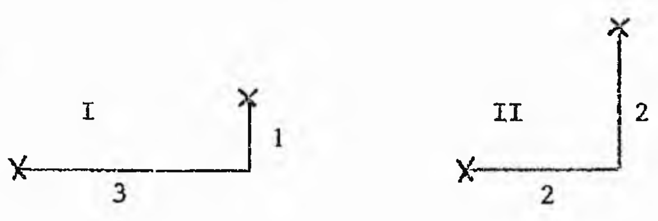


Figure 4:2: The City Block Metric illustrated

(c) The Canberra Metric (Lance and Williams (1966)) is expressed as $d_{ij} = \sum_{k=1}^{p}\left|\frac{x_{ik}-x_{jk}}{x_{ik}+x_{jk}}\right|$ and is thus the City Block metric standardised by the sum of the two dissimilarities. The Canberra metric is an example of an asymmetric metric in that we might expect the distance between

0.8 and 0.9, say, to be the same as that between 0.1 and 0.2 . For the Canberra Metric these dissimilarities would be 0.058 and 0.33 .

(d) Symmetrised Information Gain (Jardine and Sibson 1971). This metric uses Information Theory to obtain a measure of dissimilarity. It appears that this may be a very suitable metric for the type of problem which we are considering as it works within the terms of a general probabilistic framework. It is defined by

$J = \sum_{j=1}^{n}[p_{j1}\,\ell n\frac{p_{j1}}{p_{j2}} + p_{j2}\,\ell n\frac{p_{j2}}{p_{j1}}]$ and Jardine and Sibson interpret this thus: p_{ji} is the likelihood of an event and $\ell n(\frac{p_{ji}}{p_{jk}})$ the likelihood ratio is the information for rejecting event k in favour of event i for the observation j. The sum gives the average value of doing this with respect to j.

To summarise, these four dissimilarity coefficients cover a wide range of such metrics and if the results for all four are similar then we have demonstrated some confirmation of the ordering of our sequence.

Data

The data used were the final university performance of every St Andrews entrant in 1971/72 and 1972/73 to the Faculties of Arts and Science. The entrants were classified (i) by their best four SCE Higher grades, or (ii) by their best three GCE 'A' levels. An example of data such as this is displayed in Table 4:4.

The use of proportions obtained by dividing the observed number in each cell by their respective marginal total would result in rather crude indices. These would be analogous to those obtained in unstandardised life tables, as the proportions obtained would be biased towards those university and school performance categories which attract the greatest numbers of students. For example, in the 3 x 3 table given in Table 4:5, the unstandardised proportions are $p_{32} = 9/23 = 0.39$ and $p_{33} = 12/23 = 0.52$. We see that $x_{32} = 9$ is a much greater proportion of the second column than $x_{33} = 12$ is of the third, and might therefore require it to carry a proportionate weight in our analysis.

Table 4:4: Entrance qualifications and final degree results of SCE entrants to the Science Faculty in 1971 and 1972

	First	2(i)	2(ii)	Ordinary	Third	Fail
AAAA	18	22	8	6	1	2
AAAB	8	9	8	4	3	5
AABB	1	5	4	3	2	12
ABBB	0	8	11	4	1	7
ABBC	1	3	7	7	0	3
ABCC	0	1	1	3	0	5
BBBB	0	5	5	5	1	5
BBBC	0	5	6	3	2	7
BBCC	2	5	5	5	1	14
BCCC	1	2	0	4	1	10
CCCC	0	0	0	0	0	11

Table 4:5

EXAMPLE OF DATA FOR STANDARDISATION

6	4	14	24
5	8	26	39
2	9	12	23
13	21	52	$x_{ij.}$

Accordingly a standardisation procedure was implemented whereby the data were transformed such that if degree performance was to be considered the proportions were based on marginal totals for Highers and A levels of 100. When we wished to investigate school performance, the marginal totals for each degree category were transformed to equal 100. For example, for Table 4:5, column 1 is multiplied by 100/13, column 2 is multiplied by 100/21 and column 3 by 100/52 which gives row 3 a new total of 81.3. The standardised proportions are then $\bar{p}_{32} = 42.8/81.3 = 0.52$ and $\bar{p}_{33} = 23.1/81.3 = 0.26$, which represents the true weight of x_{23} more satisfactorily than was the case if the data remained unstandardised.

A further problem arose when GCE 'A' level results were considered. For Higher results, only three grades, A, B or C, represent a pass and are thus meaningful indicators of university performance. Therefore, for the best four highers, only 15 different combinations of different grades can occur. For 'A' levels, though, it is meaningful to consider grades A, B, C, D and E and so for the best three 'A' level passes there are 35 different combinations of grades into which candidates may fall. As the minimum admission requirement is only two 'A' levels, there is also a group of students who will only possess two 'A' level passes. A further complication at St Andrews is that the standard of GCE entrants is unrepresentative of the total population of English university entrants in that they include very few entrants with "poor" qualifications. Table 4:6 illustrates the entrance qualifications of the 1971 and 1972 GCE entrants. It should be noted that the table also includes the category BCF. The students in this category are those who entered the university with only two A levels, a grade B and a grade C.

Table 4:6: Entrance qualifications of GCE students 1971, 1972, 1973 entrants

AAA	21	ACC	7	BBE	7	CCD	9
AAB	42	ACD	12	BCC	13	CCE	1
AAC	14	ACE	5	BCD	21	CDD	7
AAD	5	ADD	5	BCE	6	CDE	11
AAE	4	ADE	3	BCF	2	CEE	4
ABB	35	AEE	2	BDD	7	DDD	2
ABC	36	BBB	24	BDE	6	DDE	1
ABD	15	BBC	25	BEE	1	DEE	1
ABE	10	BBD	12	CCC	7	EEE	0

Few of the students have qualifications that include fewer than 2 'B's which are very high entrance standards when compared with most other British universities. We have discussed some of the implications of this "self-selection" of GCE students in Chapter 2, but in the present context, however, we must group the English students so that there are reasonably large numbers in each performance category.

To form valid groups, it is necessary to consider our rationale for a quantitative scale of school performance. We require a measure of the worth of gaining a 'B', say, instead of a 'C' or an 'A' in terms of the optimal prediction of the subsequent performance of the student. To permit such comparisons we group the GCE students on the basis of their best two rather than their best three 'A' levels. If there were enough students in a particular category to use the best three 'A' levels then the individual category was used.

4.2.3 Results

Four sequences were derived for the four dissimilarity coefficients: for those students with Highers qualifications, those with 'A' levels, degree results for those with SCE qualifications and degree results for those with GCE qualifications.

Firstly, let us consider Highers qualifications. Two sequences were derived: for those students who entered in October 1971 or October 1972 and then for those who entered in October 1973. Table 4:7 gives the respective sequences.

Table 4:7: Sequences of Highers qualifications

1971/72

Info Gain	A^4	A^3B	AB^2C	B^4	AB^3	A^2B^2	A^2BC	B^2C^2	B^3C	BC^3
Canberra	A^4	A^3B	AB^2C	A^2BC	B^4	A^2B^2	AB^3	B^2C^2	B^3C	BC^3
City Block	A^4	AB^2C	B^4	A^3B	A^2B^2	A^2BC	AB^3	B^3C	B^2C^2	BC^3
Euclidean	A^4	AB^2C	B^4	A^3B	A^2B^2	AB^3	A^2BC	B^3C	B^2C^2	BC^3

1973

Info Gain	A^4	A^3B	A^2B^2	AB^3	AB^2C	B^3C	B^2C^2	B^4	BC^3
Canberra	A^4	A^3B	A^2B^2	AB^3	B^3C	AB^2C	B^2C^2	BC^3	B^4
City Block	A^4	A^3B	A^2B^2	AB^3	AB^2C	B^3C	B^2C^2	B^4	BC^3
Euclidean	A^4	A^3B	A^2B^2	AB^3	AB^2C	B^2C^2	B^3C	BC^3	B^4

NB A^4 = AAAA, A^3B = AAAB, A^2BC = AABC etc

We see that while the results are generally in the order we might expect, there are certain anomalies; for example, among 1971/72 entrants those students with four 'B's tended to perform better than one might expect and those with AABC worse. Examination of the standardised proportions reveals that, as a group, those students with four 'B's have a lower relative failure rate than groups we might expect to be above them.

However, when we consider the 1973 entrants we observe that the group with four 'B's perform worse than we might expect. There are two possible explanations.

Firstly, it is possible that random variation in the data accounts for some of the orderings. While there is no formal test of the validity of a sequence, we may examine the proportion of the inequalities $d(AC) \geq \max(d(A,B),d(B,C))$, (Ref. Section 4:2:1), that are broken and for these data sets these proportions are low (for example, for the 1973 data for Highers, these proportions are no greater than 0.08 for the four dissimilarity coefficients).

Secondly, it is essential to remember that the data refer effectively to two examinations taken with three or four years' difference in time. So much may happen to a student in this time that we should not expect, nor should we want (Nisbet and Welsh 1976) a perfect relationship between school and university performance and we should expect there to be outliers.

In this analysis we are investigating whether a linear scale provides the best prediction of academic performance or whether a non-linear one is more appropriate. Figure 4:4 displays the possible partial orderings of Higher qualifications. Those groups level with each other would be equal on a linear scale. We are trying to make decisions regarding the relative orderings of these grades.

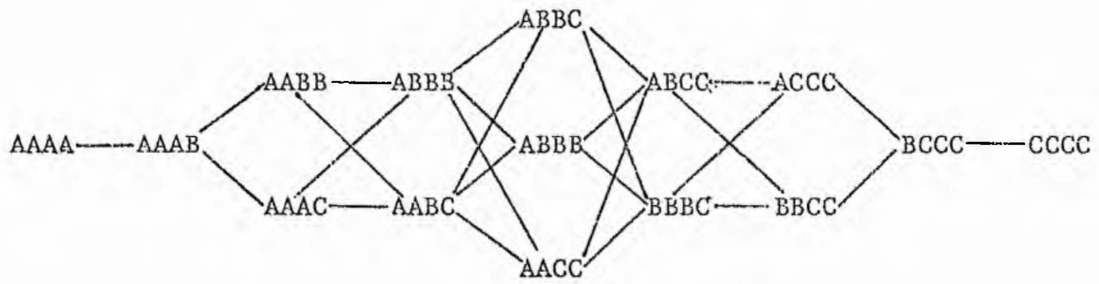


Figure 4:4: Partial orderings for Higher categories

If we are to make decisions regarding these relative orderings, it is necessary that the sequences should be similar both between dissimilarity coefficients and between years. We therefore require a measure of the agreement between two rankings. An ideal coefficient for our purposes is provided by Gordon's Alpha (Gordon 1979). This is a measure of agreement which allows for certain maverick objects disrupting what would otherwise be a very similar pair of sequences. It is defined as $\alpha_N = N - \delta_N$ where δ_N is the minimum number of objects which have to be removed from each sequence so as to ensure perfect agreement between the rankings and N is the total number of objects in each sequence. Consider the sequences for City Block and Euclidean distance metrics for 1971 and 1972 entrants (Table 4:7). In this case $\delta_{10} = 1$ because we need only remove AB^3 from both sequences to obtain a perfect agreement between the remaining sequences. Therefore $\alpha_{10} = 10 - 1 = 9$ which indicates a high level of agreement. Table 4:8 displays the respective alpha values for the Higher sequences in Table 4:7.

In general, there is a high level of agreement both between metrics and between years, which may be taken as some further confirmation of the stability of our sequences. To consider the relative positions of the groups, consider Table 4:7. Although there is some variability between the years, regarding the overall position, for each metric in both years, AB^2C precedes B^4. This is an indication that an 'A' grade predicts good performance and that the 'C' grade need not necessarily restrain performance in the university environment. For the 1971/72 data, this result is supported as in two cases out of four A^2BC precedes AB^3. These results are confirmed to some extent by the fact that they are consistent both for the data from 1971/2 and 1973. An example of inconsistent results, and of the need to consider more than one year, is provided by the results for AB^2C and B^4. While for both years AB^2C is above B^4 the position of the groups in sequences for the two data sets is very different. In 1971/2 students with these combinations of grades performed well comparatively while in 1973 the opposite was true. When we construct a sequence for Highers for use in the next section we will use those results that can, to an extent, be validated. Certain other results seem clear: among well-qualified students, those students whose best four Higher passes are four 'A's perform, as a group, better than any other and among the less-qualified students, the three groupings B^3C, B^2C^2 and BC^3 are, among 1971/72 entrants, the lowest three groupings for each metric. In 1973, with one exception, those four categories consisting of students without an 'A' grade were the lowest four groups. The problems faced by students entering with exceptionally poor grades is highlighted by the fact that of eleven students in the years under question whose best four Highers were four 'C's, nine failed their first year, one failed second year and the other third year (these data were not included in these analyses).

Table 4:8: Values of Gordon's alpha for Highers' sequences

	1971/72 (N = 10)			1973 (N = 9)		
Canberra	8			7		
City Block	7	7		9	7	
Euclidean	7	7	9	7	8	7
	Info gain	Canberra	City Block	Info gain	Canberra	City Block

α (1971/72,73) (N = 9)	5	6	7	6
	Info gain	Canberra	City Block	Euclidean

The relative performance of students with moderate qualifications is less clear. It is likely that it is these students whose performance is most prone to outside influences which restricts general inferences.

In summary, this section has given us the result that for SCE Higher grades an 'A' and a 'C' predicts a better university performance than two 'B's.

4.2.4 GCE 'A' Levels

Secondly, we investigate the results for those students with GCE qualifications. Table 4:9 displays the sequences obtained for GCE qualified students, and an initial inspection indicates that, as for Highers students, the position is clear at the upper and lower ends of the sequences but less clear in the middle.

It is important to remember that the "problem" of the level of failure at St Andrews is not so much one of a high Scottish failure rate but, rather, of a low GCE failure rate. We are in no way attempting to predict first year GCE failure which, as we will see in Chapter 5, is a fruitless exercise. Instead, we shall investigate whether groups of students with similar combinations of 'A' level grades perform, as a group, better than others. Values of Gordon's alpha are also displayed in Table 4:9 and we observe that, as for the Highers sequences, there is a high level of agreement between the sequences. To compare different combinations of grades, we see that the top grades for 1971/72 are AAA, AAB and AAC/D/E. Similarly, for both years, the group whose best 'A' level performance was a 'C' grade performed least well on each metric, while those with at most a 'B' perform, as a group, only a little better. Among 1973 entrants, the sequences confirm that those students with at least an 'A' perform better than those with at least a 'B', although there is some variation in the upper categories.

Table 4:9: Sequences of GCE 'A' level qualifications

1971/72

Info gain	A^3	A^2C+	A^2B	AB^2	ABC	B^2C	AC^2	B^3	BCD+	C+
Canberra	A^2C+	A^3	A^2B	AB^2	B^3	ABC	B^2C	AC^2	BCD+	C+
City Block	A^3	A^2C+	A^2B	AB^2	ABC	B^2C	AC^2	BCD+	B^3	C+
Euclidean	A^3	A^2B	A^2C	AB^2	ABC	B^2C	B^3	AC^2	BCD+	C+

1973

Info gain	A^3	A^2+	A+	B^2+	BC^2	C+
Canberra	A^2+	A+	A^3	B^2+	BC^2	C+
City Block	A^2+	A+	A^3	B^2+	BC^2	C+
Euclidean	A^2+	A+	A^3	B^2+	BC^2	C+

1971/72 Gordon's Alpha (N = 10) 1973 Gordon's Alpha (N = 6)

	1971/72			1973		
Canberra	8			5		
City Block	9	8		5	6	
Euclidean	8	8	8	5	6	6
	Info gain	Canberra	City Block	Info gain	Canberra	City Block

To consider the relative positions of two 'B' grades with an 'A' and a 'C', we must consider 1971/72 entrants. In three cases out of four the group with at least an 'A' and a 'C' out-perform those with three 'B' grades. As the group denoted by ABC also includes those entrants with ABD and ABE, it is fair to conclude that, as with Highers, the 'A' grade is a relevant predictor of good performance especially as many students specialise in a subject in which they gained an 'A' grade. This result is supported by the result that those with AAC, AAD or AAE entrants perform, in each case, above those with ABB.

In summary, we are not trying to predict failure, but overall performance. Prediction on the basis of 'A' level performance is again demonstrated to be unreliable in the "middle" grades, but clear differences are observed between the upper and the lower end of the sequences. Furthermore, we conclude that an 'A' and a 'C' is likely to predict a better performance than two 'B' grades.

4.2.5 Degree Performance

Final degree performance is considered separately for those students with SCE and those with GCE qualifications. Tables 4:10 and 4:11 display the relevant results.

We consider initially the results for SCE qualified entrants. There is a high level of agreement between the metrics for both sets of sequences. For the 1971/72 data the only degree performance category which changes is the undivided second. A possible explanation is that it is taken by fewer SCE than GCE students as there is a much greater tendency for SCE Arts students to take an Ordinary (Newfield 1963; Robbins 1963).

More importantly, let us compare the results for SCE and for GCE students across all four metrics. For both sets of qualifications the entrance qualifications of those students who gain a first are, as a group, above those for all other degrees but there is some disagreement

Table 4:10: Sequences of degree categories for SCE qualified entrants

1971/72

Info gain	First	2(i)	2(ii)	Ordinary	Undiv 2	3	Fail
Canberra	First	2(i)	2(ii)	Undiv 2	Ordinary	3	Fail
City Block	First	Undiv 2	2(i)	2(ii)	Ordinary	3	Fail
Euclidean	First	2(i)	Undiv 2	2(ii)	Ordinary	3	Fail

1973

Info gain	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail
Canberra	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail
City Block	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail
Euclidean	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail

1971/72 Gordon's Alpha (N = 7) 1973 Gordon's Alpha (N = 6)

	1971/72 Info gain	1971/72 Canberra	1971/72 City Block	1973 Info gain	1973 Canberra	1973 City Block
Canberra	6			6		
City Block	6	6		6	6	
Euclidean	6	6	6	6	6	6

α (1971/72,73) (N = 6)	Info gain	Canberra	City Block	Euclidean
	5	5	5	6

over the position of upper and undivided seconds. For GCE qualified students, the very high standard of entrants to the Arts faculty and the propensity with which they gain undivided seconds tends to raise the undivided second in the sequence. We shall see in Section 4.5 that the undivided seconds are assigned a high weight on the quantitative degree scale. Again, those GCE students awarded a third class degree tend, as a group, to be the least well qualified GCE students at St Andrews. We will argue that there should be no academic reason for a GCE qualified student to fail his first year, the year when most failures occur. This is supported by the fact that most GCE entrants who fail are well qualified. It is not surprising, therefore, that in the series for GCE students a third comes below a fail.

Table 4:11: Sequences of degree categories for GCE qualified entrants

1971/72

Info gain	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail	3
Canberra	First	Undiv 2	2(i)	2(ii)	Ordinary	Fail	3
City Block	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail	3
Euclidean	First	2(i)	Undiv 2	Ordinary	2(ii)	Fail	3

1973

Info gain	First	Undiv 2	2(i)	2(ii)	Ordinary
Canberra	First	Undiv 2	2(i)	2(ii)	Ordinary
City Block	First	Undiv 2	2(i)	2(ii)	Ordinary
Euclidean	First	2(i)	Undiv 2	2(ii)	Ordinary

1971/72 Gordon's Alpha (N = 7) 1973 Gordon's Alpha (N = 5)

	1971/72			1973		
Canberra	6			5		
City Block	7	6		5	5	
Euclidean	6	5	6	4	4	4
	Info gain	Canberra	City Block	Info gain	Canberra	City Block

α (1971/72,73)	4	5	4	4
(N = 5)	Info gain	Canberra	City Block	Euclidean

For both SCE and GCE students an ordinary degree rates higher than a third for all metrics. The long tradition of well-qualified SCE students taking an ordinary makes this an unsurprising result for Scots students, but it is interesting that there is some tendency for reasonably well-qualified GCE students to take an ordinary.

For 1973 entrants, there is an almost perfect agreement between the sequences for different metrics. Due to lack of data, it was not possible to include results for those students who gained a third or for GCE students who failed. However, we notice firstly that for GCE students the undivided second comes above the upper second for three metrics while for SCE students the upper second is above the undivided second for each metric.

There has been some criticism (McPherson 1979) of using school qualifications as a predictor of final degree performance due to the length of time between the two assessments. However, while we must expect that we will not be able to explain all of the variation in performance, the results reported throughout this thesis suggest that there is a positive relationship between school and final university performance. The consistency and ease of interpretation of the results for the four metrics discussed in this section is some confirmation of the reliability of the results.

In summary, then, we have seen that the school qualifications of GCE students who take an undivided second and of SCE students who take an ordinary are, as a group, above those of their contemporaries taking a divided second or a third respectively. Finally, few GCE students are awarded a third class honours, but those that are tend to have the lowest entrance qualifications of any group of GCE students.

4.3 SEQUENCE SLOTTING

The series analyses described in the previous section have enabled us to derive an individual ordering for each of the two groups. However, it does not provide us with an overall comparison of GCE and SCE school qualifications as predictors of university performance and hence an ordinal scale for the comparison of individual grades. This requires that we combine the two orderings into one. Although the preceding methods could have been used, it was felt that the lack of constraints available for the "rogue" grades would invariably leave a degree of uncertainty about any results. Accordingly, it was decided to use an alternative method to combine the two orderings.

4.3.1 Method

The technique used in this section was developed by Gordon (1973). It requires two sequences which are ordered individually. The aim is to slot the two sequences together to give satisfactory local fits subject to these orderings. To do this we assume that a similarity measure between all pairs of objects can be defined, and consider that the insertion of an object in one sequence between a pair of objects in the other sequence is more or less satisfactory according to its similarity with both of them.

An example of two sequences which may be slotted together is provided by Gordon (1973) and is illustrated in Table 4:12 .

Table 4:12: The slotting of two sequences $s_1 = \{\alpha_1 \ldots \alpha_{10}\}$, $s_2 = \{\beta_1 \ldots \beta_8\}$

α_1	α_2		α_3		α_4	α_5			α_6		α_7		α_8			α_9	α_{10}
		β_1		β_2			β_3	β_4		β_5		β_6		β_7	β_8		

A formal statement of the problem is as follows. To slot the two sequences $s_1 = \{\alpha_1 \ldots \alpha_m\}$, $s_2 = \{\beta_1 \ldots \beta_n\}$, we introduce dummy objects α_0, α_{m+1} such that a_0 precedes α_1 and α_{m+1} follows α_m and consider that α_0, α_{m+1} bracket s_2. Similarly, we introduce a β_0 and β_{n+1}.

Now, define

$$s(j) = i \quad \text{if} \quad \beta_{i-1} \le \alpha_j \le \beta_i \ , \quad j = 1,\ldots,m$$

and $$t(k) = j \quad \text{if} \quad \alpha_{j-1} \le \beta_k \le \alpha_j \ , \quad k = 1,\ldots,n \ .$$

For a fit to be consistent, $\{\alpha_j, s(j);\ j = 1,..,m\}$ and $\{\beta_k, t(k);\ k = 1,\ldots,n\}$ must give the same ordering to $s_1 \cup s_2$. For a fit to be order preserving, $s(j), t(k)$ must be non-decreasing sequences of integers taking values in $(1,\ldots,n+1)$ and $(1,\ldots,m+1)$ respectively. We assume that a relevant dissimilarity exists and seek to minimise the discordance of the sequences defined by:

$$\sum_{j=1}^{m} \{d(\alpha_j, \beta_{s(j)}) + d(\alpha_j, \beta_{s(j)-1})\} + \sum_{k=1}^{n} \{d(\alpha_{t(k)}, \beta_k) + d(\alpha_{t(k)-1}, \beta_k)\}$$

subject to the above restrictions of consistency and preserving the order of the sequences. In other words, the aim is to minimize the sum for all objects of both sequences of the dissimilarities between these objects and those immediately preceding and the immediately following objects in the other sequence.

Gordon (1973) describes a heuristic algorithm which approximates to this minimisation. However, Delcoigne and Hansen (1975) have described an exact solution to the minimisation problem. They show that it may be solved by dynamic programming where the model is "discrete, deterministic and finite horizon". They demonstrate that the problem reduces to finding the shortest path in a graph $G = (X,u)$ and give the algorithm as follows:

"At a given stage, the state of the system is defined by the indices j and k of the last objects of the sequences s_1 and s_2 already in the common sequence; this stage is associated with a node $x_i = (j,k)$ of G. The only two feasible decisions are to increment j or k, unless j = m or k = n; two arcs $(x\ ,x_p)$ and $(x\ ,x_q)$ of G are associated with these decisions. The immediate values u (j,k; j+1,k) and u (j,k; j,k+1) corresponding to these decisions are $d(\alpha_{j+1},\beta_k) + d(\alpha_{j+1},\beta_{k+1})$, $d(\alpha_j,\beta_{k+1}) + d(\alpha_{j+1},\beta_{k+1})$, respectively; lengths equal to those values are given to the arcs $(x\ ,x_p)$ and $(x\ ,x_q)$. Noting $f_{0,j,k}$, the value of an optimal subpolicy $\overline{w}_0$, from the state $x_0 = (0,0)$ to the state $x\ = (j,k)$, we obtain from Bellman's optimality principle

$$f_{0,1,0} = f_{0,0,1} = 2d(\alpha_1,\beta_1)$$

because of the dummy objects α_0 and β_0, and because $\alpha_0 \equiv \alpha_1$, $\beta_0 \equiv \beta_1$, $\alpha_{m+1} \equiv \alpha_m$, $\beta_{n+1} \equiv \beta_n$.

$$f_{0,1,1} = \min \{f_{0,1,0} + d(\alpha_1,\beta_1) + d(\alpha_2,\beta_1)\ ,\ f_{0,0,1} + d(\alpha_1,\beta_1) + d(\alpha_1,\beta_2)\}$$

$$f_{0,j,k} = \min \{f_{0,j,k-1} + d(\alpha_j,\beta_k) + d(\alpha_{j+1},\beta_k)\ ,\ f_{0,j-1,k} + d(\alpha_j,\beta_k) + d(\alpha_j,\beta_{k+1})\}$$

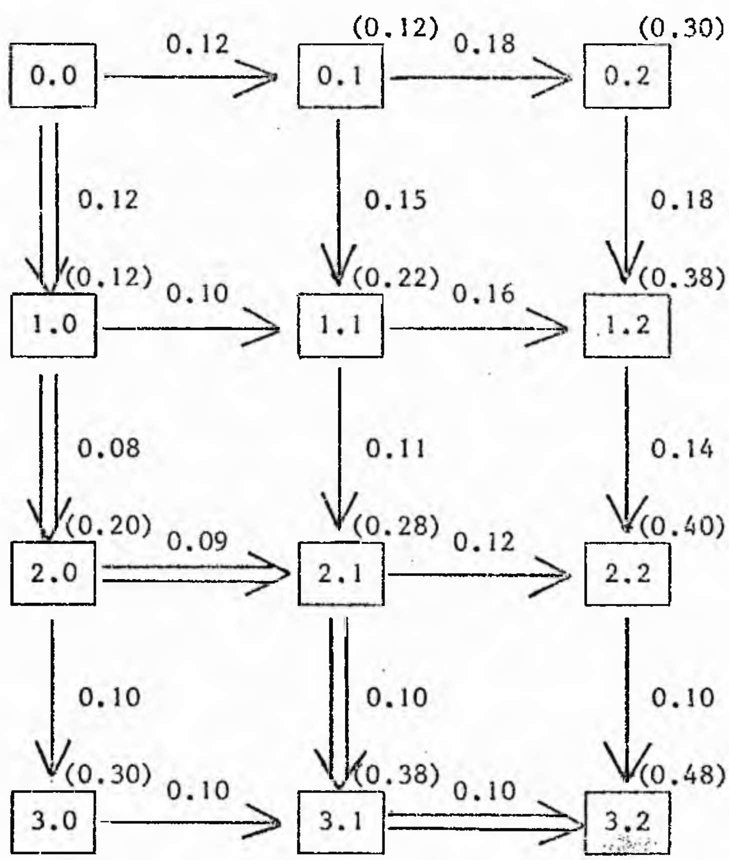
for $j \leq m$; $k \leq n$".

As an example, let us consider the slotting of Firsts, 2(i)s, 2(ii) s and undivided seconds of GCE entrants in 1971 and 1972, for the extremely well-qualified students alone. In other words, this is just a small subset from the larger problem. Table 4:13 shows the matrix of dissimilarities for the two groups (using absolute distance metrics). We want to slot an undivided second and an ordinary into the sequence on the left hand side. The result is depicted graphically in Table 4:14. Gordon and Reyment (1979) describe this depiction thus: "Consider a collection

Table 4:13: Matrix of dissimilarities between degree categories based on one school qualification (AAAA)

Degree Classification	Undiv. 2	Ordinary
First	0.06	0.09
2(i)	0.04	0.07
2(ii)	0.05	0.05

Table 4:14: Results of slotting example



NOTE I. No's in brackets are cost to that cell.

2. Double arrow denotes route of minimum cost

of towns. There exist turnpikes connecting some towns, but traffic may only move along a road in the direction indicated by the arrow, ie S or E. We may find the cheapest route to (m,n) recursively". Note that only two roads enter a town, which is analogous to the problem described above in that the cost of using a road is given by a pair of dissimilarities, corresponding to the increased contribution to the discordance yielded by adding another object to the j^{th} slotting. At each stage the cost will be the sum of the dissimilarities between the new object and the two between which it is to be slotted. For example, the cost to the discordance of placing an ordinary between an upper and a lower second (ie between 2:1 and 2:2) would be the dissimilarity between an upper second and an ordinary plus that between a lower second and an ordinary (ie 0.7 + 0.5 = 0.12). The slotting in this example would be found by the route of minimum cost (minimum costs at each stage appear in brackets). Therefore the slotted sequence would be First, 2(i), Undiv.2, 2(ii), Ordinary.

This algorithm is incorporated in the sequence slotting program used in this analysis, and the results obtained are described below.

4.3.2 The Data

As in the seriation analyses described in section 4:2, it was necessary to standardise the data so as to restrict the influence of those categories into which more observations fell than others. The standardisation was performed in the same way as that described in section 4:2. The object of the sequence slotting was to obtain one comparative scale of SCE and GCE qualifications using the algorithm described above. As this algorithm requires that the orders of the two sequences to be slotted are fixed the results of the seriation analyses were used as a base from which to impose such orderings. The two sequences are displayed in Table 4:15 and require some explanation. They are ordered according to two criteria. Firstly, the results of the seriation analyses were used to order the categories such that a category containing an A grade and a C grade was placed above one with two B's, all other grades being equal. Secondly, it was assumed that, all other grades being equal, an A grade was ordered above a B, and a B above a C etc. This second criterion is open to criticism in that it is not always supported by the results of the seriation analyses. For example, for SCE students the category ABBC consistently places above categories such as ABBB, an ordering which, a priori, we would not expect. However there are two arguments in support of this criterion. Firstly, if we are to construct a scoring system comprising scales for GCE and SCE grades it is essential that it should be readily interpretable. There can be no convincing explanation of an ordering which places a B above an A. Secondly as we have stated on Page 124, most of the results that contradict this criterion are not validated across either both sets of years or across different metrics. On the other hand, the criterion that an A and a C should be placed above two B's is supported by the results for both different years and metrics. Therefore while criticism of this second criterion is justified, there are sound grounds for its inclusion. Furthermore we shall see in chapter 5 that further analyses will support these criteria.

4.3.3 Results

We will now consider the results of the sequence slotting analyses with respect to the goals introduced in section 4:1 : to construct comparative scales of SCE and GCE qualifications and to assess their usefulness as predictors of performance.

The analysis was initially performed for all entrants to St. Andrews in 1971 and 1972. The results are displayed in the third row of Table 4:15 and in Table 4:16 and the data in Tables 4:17 and 4:18. We shall first discuss the results and then describe how they may be used to construct a scoring system.

Table 4:15: Sequence slotting for 1971/72 entrants

	1	2	3	4	5	6	7	8	9	10	
SCE	A^4	A^3B	A^2B^2	A^2BC	AB^3	AB^2C	B^4	B^3C	B^2C^2	BC^3	: $\{S_i ; i = 1,2...10\}$
GCE	A^3	A^2B	A^2C	AB^2	ABC/D	B^3	AC^2	B^2C	C+	D+	: $\{G_i ; i = 1,2...10\}$
Slot	G1; S1; G2; S2; G3; G4; G5; G6; G7;G8 ; S3; S4; S5; S6; S7; G9; G10; S8; S9; S10										

In chapter 1 we noted that there appeared to be a bimodal performance among SCE students, some performing very well and others very poorly. Table 4:16 confirms this and helps us to identify the SCE students who are likely to perform very well as being those with at least three A grades in their best four Highers. We have therefore identified an upper threshold for SCE performance of three A grades. At the lower end of the sequence we see that those SCE students who include a C grade among their best four Highers perform less well than any other group of students.

Table 4:16: Results of slotting sequence analyses

1971/72 entrants

GCE	SCE
A^3	
----------	A^4
A^2B	
----------	A^3B
A^2C	
AB^2	
ABC/D	
B^3	
AC^2	
B^2C	
----------	A^2B^2
----------	A^2BC
----------	AB^3
----------	AB^2C
----------	B^4
C+	
D+	
----------	B^3C
----------	B^2C^2
----------	BC^3

1973 entrants

GCE	SCE
A^3	
----------	A^4
A^2B	
A^2C	
----------	A^3B
AB^2	
ABC/D	
B^3	
AC^2	
----------	A^2B^2
B^2C	
----------	A^2BC
----------	AB^3
----------	AB^2C
----------	B^4
C+	
D+	
----------	B^3C
----------	B^2C^2
----------	BC^3

Table 4:17: Standardised proportions attaining different final degrees of entrants in 1971/72 with GCE qualifications

	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail
AAA	.50	.11	.07	.12	.04	.16
AAB	.37	.22	.16	.00	.08	.17
AAC+	.08	.25	.42	.00	.17	.07
ABB	.18	.21	.10	.06	.12	.33
ABC+	.20	.21	.07	.26	.10	.15
BBB	.10	.21	.15	.24	.20	.10
ACC	.18	.11	.20	.18	.15	.19
BBC	.06	.17	.10	.24	.26	.17
C+	.10	.12	.24	.22	.14	.19
D+	.07	.08	.26	.18	.31	.11

Table 4:18: Standardised proportions attaining different final degrees of entrants in 1971/2 with SCE qualifications

	First	2(i)	Undiv 2	2(ii)	Ordinary	Fail
A^4	.43	.06	.25	.13	.10	.03
A^3B	.20	.22	.17	.18	.12	.11
A^2B^2	.09	.20	.13	.22	.16	.18
A^2BC	.00	.26	.22	.13	.25	.13
AB^3	.05	.18	.13	.27	.15	.22
AB^2C	.11	.30	.05	.12	.28	.15
B^4	.05	.20	.21	.19	.11	.24
B^3C	.00	.14	.20	.20	.23	.23
B^2C^2	.11	.00	.14	.17	.16	.42
BC^3	.11	.00	.10	.00	.22	.57

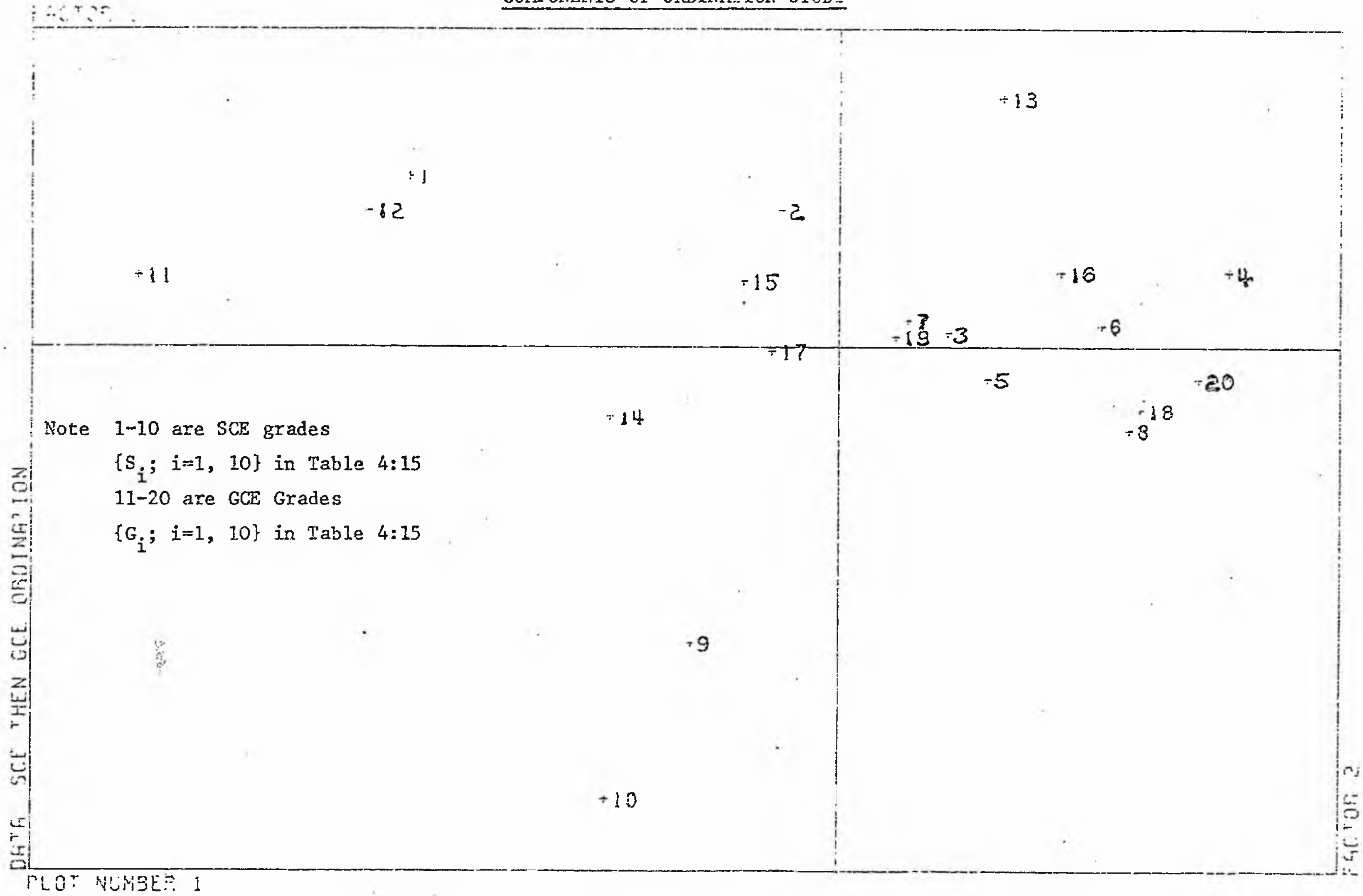
The most interesting result is the "clustering" of the two groups of students (SCE and GCE qualified). These groups of moderately well-qualified GCE students perform, on average, better than the moderately qualified SCE students.

It is necessary to make a caveat here regarding the possibility of "blocking" effects. Gordon and Reyment (1979) report that experience has shown that a certain amount of "blocking" may occur where groups from the same sequence cluster together. They state that blocking may highlight interesting differences between the sequences, and may be due to there being little variability in the data. Alternatively, blocking may occur in points which differ markedly, but in this case we would get high values of the discordance ψ (see Section 4.3.1). This does not happen in this case.

However, there is no formal test of the size of ψ. Therefore as a validation of the sequence produced in Table 4:15, an ordination study was undertaken. The method used was to calculate the principal components of the standardised proportions of students in each degree category with a particular school qualification category. Table 4:19 shows that much of the variation is due to the extremely well and poorly qualified students but that in the middle there is a clear clustering effect.

This "clustering" is the first clear indication that the differences between SCE and GCE students do remain through to graduation. Also, the difficulties experienced by the poorly qualified GCE students at St Andrews (poorly is used only in relation to the overall standard of GCE entrance qualifications at St Andrews; in other universities their qualifications would be regarded as good) are demonstrated by the low position of the groups of GCE students with no better than a 'C' grade at 'A' level. We will see in Chapter 5 that it is a worthless exercise to attempt to predict GCE failure, but it is possible to make some progress if we consider overall performance instead.

TABLE 4:19 PLOT OF FIRST TWO PRINCIPAL COMPONENTS OF ORDINATION STUDY



As a validation of the above results, a similar sequence slotting analysis was performed for the 1973 entrants. The final sequence was the same as that for 1971 and 1972 entrants except that S3(AABB) comes before G8(BBC) and G3(AAC) comes above S2(AAAB).

We now consider how this analysis will permit us to assign scales to SCE and GCE qualifications. In order to evaluate the scales we require the six assumptions displayed in Table 4:20 and we discuss them below.

Table 4:20: Assumptions required to calculate scales

(1)	AC > BB (GCE and SCE)
(2)	GCE (BBC) = SCE (AABB) : GCE (ABB) = SCE (AAAB)
(3)	SCE (AAAA) > GCE (AAB)
(4)	the scales consist of integers
(5)	SCE (CCCC), GCE (DDD - EEE) are poor qualifications
(6)	GCE (E) = 1 ; GCE(D)=2

The first assumption concerns the relative weight of an A and a C grade compared with two B grades. Our starting point has been the linear scales used commonly in previous studies which imply that A+C = B+B. In section 4:3 we have questioned the validity of this equality and concluded that at St. Andrews it is more appropriate to give extra weight to an A grade and so our first assumption is A+C > B+B.

Secondly, the sequence slotting analyses for the two data sets are inconsistent for two comparisons. In 1971/2, the group of GCE entrants with at least two B's performed better than the group of SCE entrants whose best four Highers were AABB, while for 1973 students this relationship was reversed. At the upper end of the scale a similar reversal occurred between those SCE students whose best four highers were AAAB and those GCE students with at least two A's and a C. An initial approach is to set the two groups of grades equal to each other in the scoring system. Unfortunately there is a problem with the latter pair. If we assume that SCE (AAAB) = GCE(AAC) we are unable to construct a scale using this and our other conditions as there will be inconsistencies in the inequality conditions. In order to decide how to order these categories we must consider the structure of the GCE category AAC+. This group also includes those students whose best three A levels are AAD and AAE. It seems fair to assume, therefore, that the sequence will be undervaluing the AAC category. Furthermore, we shall see below that it is possible to construct a scale if we assume that SCE(AAAB) = GCE(ABB), that GCE(AAC) > GCE(ABB) and that GCE(AAC) > SCE(AAAB). While there is, necessarily, a certain amount of subjectivity in this decision, the resulting scale will be justified in later sections of the thesis.

Thirdly, we assume that those SCE students with at least four A grades will perform better than the GCE students with two A's and a B.

Fourthly, one of the main objectives of our scale is that it should be readily interpretable. To achieve this, we assume that the values assigned to each grade will be whole numbers.

Finally, in order to construct a scoring system it is necessary that some grades are fixed as a base from which the scales will be derived. It is unnecessary to have baselines on both scales so, as both the group of GCE students with primarily D's and those with primarily E's perform poorly, the fifth assumption is that we assign a score of 1 to GCE 'E' and 2 to GCE 'D'.

Let us now consider how we might use these assumptions to form a scoring system. We start by considering assumptions (1) and (4). As the scales are to be composed of integers then

$$\text{for SCE,} \quad A \geq 4 \qquad\qquad (4.3.1)$$

$$\text{and} \quad \text{for GCE,} \quad A \geq 6.$$

Now, let GCE 'A' = P, SCE 'A' = Q , then from assumption (3),

$$3P > 4Q > 2P + B. \qquad\qquad (4.3.2)$$

Consider the following situations.

(a) $Q = 4 \quad 3P > 16 > 2P + B$

$P = 6,\ B = 2$ or $P = 7,\ B = 1.$

Neither of these solutions is acceptable since under assumption (6) we have assigned the values 2,1 to GCE D,E respectively. The first solution cannot be used because under assumption (5) the minimum value for GCE C is 3.

(b) $Q = 5 \quad 3P > 20 > 2P + B$

$P = 7,\ B \leq 5$ or $P = 8,\ B \leq 3$.

The first of these solutions is acceptable but the second cannot be used for the same reasons as in (a).

Let us consider the first of these solutions. Using assumption (2) we see that if P=7, B=5 then $B^* = P + 2B - 3Q = 2$ (where B* = SCE'B'). This necessarily constrains SCE'C' to equal 1 and, furthermore, from assumption (2) we calculate GCE'C' as $2Q + 2B^* - 2B = 4$. Hence our scoring system using this solution will be SCE{A=5, B=2, C=1}; GCE{A=7, B=5, C=4 D=2, E=1}.

(c) $Q = 6 \quad 3P > 24 > 2P + B$

$P = 9,\ B \leq 5$ or $P = 10,\ B \leq 3$ or $P = 11,\ B = 1.$

The first of these is not acceptable because from assumption (2), if

P=9, B=5, Q=6 then B*=1. This cannot be acceptable as SCE'C' must be at least 1 and hence B* must be at least 2.

We may obtain similar results for any value of Q. As Q increases it is possible to obtain satisfactory solutions. For example, if Q = 8 we may obtain the solution P = 11, B = 9, B* = 5, GCE 'C' = 8. The value of GCE 'C' is constrained to equal B − 1. Hence, as the value of Q increases the values of P,B,B* and GCE 'C' will also increase and therefore become further from the fixed values of GCE 'D' and 'E'. We reject such solutions for three reasons. Firstly, although the groups of students with primarily GCE 'D's and 'E's do not as a group perform very well, it seems wrong intuitively to create a large gap between them and the better grades. There are groups of students with 'D's and 'E's as auxiliary grades who do perform well. Secondly, as the values become larger so the number of values which the combined groups may take increases to a maximum of 15 for Highers grades and a maximum of 35 for GCE grades. In the introduction to this chapter, we stated that we wished to reduce the number of values which the combined groups could take and therefore we require a solution which reduces the number of cells. Thirdly, and most importantly, we will see in Chapter 5 that under the scoring system from case (b) above, ie SCE {A = 5, B = 2, C = 1} GCE {A = 7, B = 5, C = 4, D = 2, E = 1}, the logistic model with which we will predict failure provides the best fit to the data. Fourthly, Table 4:21 displays the correlations between school score and university performance for the four scoring systems described above. In no case is the correlation for the derived scale less than that for one of the alternative scales, although in no case is an increase significant.

It is important to note that although these results are consistent the validation is extremely limited as it is based on the data on which the scales were constructed. It is to be hoped that further validation will be carried out on future data.

Table 4:21: Correlation between school and university performance for different scoring systems

		All students	SCE alone	GCE alone
I	1971	.36	.42	.24
	1972	.35	.38	.19
	1973	.38	.45	.22
II	1971	.36	.42	.24
	1972	.33	.38	.19
	1973	.36	.41	.21
III	1971	.36	.42	.21
	1972	.35	.38	.18
	1973	.36	.42	.20
IV	1971	.35	.41	.23
	1972	.34	.38	.18
	1973	.35	.40	.15

I: SCE {A=5; B=2; C=1}, GCE {A=7; B=5; C=4; D=2; E=1}
II: SCE {A=3; B=2; C=1}, GCE {A=5; B=4; C=3; D=2; E=1}
III: SCE {A=4; B=2; C=1}, GCE {A=6; B=4; C=3; D=2; E=1}
IV: SCE {A=8; B=4; C=1}, GCE {A=11; B=8; C=4; D=2; E=1}

These results demonstrate that it is possible to construct, in a scientific manner, a scoring system which permits a comparison of the relative worth of GCE and SCE grades as predictors of university performance. However it is not yet apparent that our scoring system will provide the best predictions of university performance. We shall demonstrate in the next chapter that it does provide better predictions than any of a group of rival scoring systems.

4.3.4 The CSYS

To complete our scoring system we need to add a component to allow for the performance by SCE students in any CSYS subjects they may have taken. Performance in CSYS subjects is not taken into account officially by admissions officers in Scottish universities but there are a number of reasons for including CSYS results in our SCE scale.

Firstly, in Chapter 6 we will observe that those students who had undertaken a CSYS course report that they are more used to working on their own, and more used to organising their work than do their contemporaries who had taken only Highers. Both these traits are likely to assist the CSYS qualified students to settle down quickly to productive university study.

Secondly, an extra year in secondary education and the extra knowledge gained during this year are likely to give the student a stronger academic base from which to commence a university career.

There is one further reason why CSYS results must be included. It is common for students to receive an unconditional offer of a university place in the February of their sixth year. Many students then relax their efforts and either withdraw from the examination or perform poorly (Gilroy 1979). Such students cannot be said to have furthered their academic knowledge or to have profited from their sixth year in the way in which it was intended.

The CSYS is an examination which it is not possible to fail and so we must decide to which grades we will assign weights. It is generally regarded that D and E grades are awarded to students whose performance is extremely poor (McPherson and Neave 1976) and these are discounted. Our most important decision concerns whether we should assign a weight to a 'C'.

Table 4:22: Chi-squared values to compare the overall performance of students with different entrance qualifications

		Highers alone		No better than a 'C' grade		No better than a 'B' grade	
		1971/72	1973	1971/72	1973	1971/72	1973
No better than a 'C' grade	Arts	31.92	10.61				
	Science	2.58	6.60				
No better than a 'B' grade	Arts	15.05	9.78	46.08	4.47		
	Science	31.64	15.63	32.05	11.18		
At least an 'A' grade	Arts	94.23	21.69	156.91	27.13	50.74	24.53
	Science	54.45	9.84	104.85	45.56	48.51	29.96

NB in each case df = 6

Table 4:22 contains details of χ^2 tests between the distribution of the degree performance of those students who entered with Highers alone and those with different levels of CSYS performance. In the Science faculty, there is no evidence to suggest that those students whose best CSYS grade is a 'C' perform as a group better than those who enter with Highers alone, while in Arts the evidence suggests they perform less well. On the other hand, for both faculties we reject the null hypothesis that there is no difference between the group with Highers alone and those whose best CSYS grade is a 'B' or an 'A'. Secondly, those students whose best grade at CSYS was an 'A' performed, as a group, significantly better than those whose best grade was a 'B'. We shall therefore assign weights to CSYS grades 'A' and 'B' alone. Use of a logistic standardisation (see Section 4.4) suggested that a linear relationship between a 'B' weight and an 'A' weight was appropriate and therefore it was decided to assign weights A = 2, B = 1 to CSYS grades. We will assess this decision in Chapter 5.

4.3.5 Differences Between Faculties

One of the reasons for the large difference in the discontinuation rates between the Arts and the Science faculties is that there is greater competition for places in the Arts Faculty. This has led to entrants to the Arts Faculty having, as a group, a higher standard of school qualifications. The mean values of the entrance qualifications based on the scale derived in Section 4.3.1 are displayed in Table 4:23.

Table 4:23: Mean values of school qualifications of entrants in 1971 and 1972

	Science	Arts
GCE	13.5	15.1
SCE	12.7	13.5

To investigate the extent to which the differences between the faculties in both qualifications and performance affects the relationship between school and university performance, the sequence slotting analysis was performed separately for each faculty.

4.3.5.1 Results

Let us first consider the relationship in the Arts Faculty where the number of students who had their studies officially discontinued is low. To enable there to be sufficient numbers in each of the 'A' level categories, it was necessary to amalgamate various combinations of grades. For the results in Table 4:24, AA+ comprises the groups AAB, AAC and AAD. A+ consists of any group with one grade 'A' pass. B+ represents all those groups which have at least one 'B' grade but no 'A' grades, and C+ is made up of all those students with no better than a 'C' grade. Table 4:24 illustrates the results of the analysis for entrants to the Arts Faculty in 1971 and 1972.

Table 4:24: Sequence slotting for 1971 and 1972 entrants to the Arts Faculty

GCE	A^3		A+			BB+		B+	C+					
SCE		A^4		A^3B	A^2B^2		AB^3			AB^2C	B^4	B^3C	B^2C^2	BC^3

The results are very similar to those of the overall analysis. The only differences are that the less well qualified GCE students perform, as a group, better than the comparable group in the overall analysis, and the slot between BB+ and A^2B^2 is reversed from the overall analysis. These may be interpreted thus: firstly, lesser qualified GCE Arts students are relatively well qualified - the poorly qualified GCE students are in the Science Faculty. This is reflected by the high position of the GCE (C+) group. Secondly, the GCE (BB+) also includes students from groups BBD and BBE, the influence of these groups being reflected in the slot. Thirdly, it is important to consider the national difference in the type of degree taken by students in the Arts Faculty. Traditionally, many SCE students tend to take an Ordinary degree. Many GCE students, on the other hand, are more likely to be awarded an undivided second. This will have the effect of "upgrading" the GCE qualifications.

The analysis was performed for 1973 entrants as a validation of the 1971/72 results. The standard of GCE entrants to the Arts Faculty in 1973 was very high and so it was not possible to include relevant groups of lower qualified entrants. Instead, it was possible to include both an AA+ group and an A+ group. The results are displayed in Table 4:25, reference to which demonstrates that the results are similar to those for 1971/72 entrants.

Table 4:25: Results of sequence slotting analysis for well qualified 1973 entrants to the Arts Faculty

GCE	A^3		AA+		A+	
SCE		A^4		A^3B		A^2B^2

Secondly, we consider the Science Faculty. It was again necessary to amalgamate various 'A' level categories so as to permit a valid analysis. The results for both 1971 and 1972 entrants and for 1973 entrants are given in Table 4:26.

Table 4:26: Results of sequence slotting for entrants to the Science Faculty

1971/72	GCE	A^3		AA+		A+		BB+		B+		C+	
	SCE		A^4		A^3B		A^2B^2		AB^3		AB^2C B^4 B^3C		BC^3
1973	GCE	A^3		A+		BB+		B+		C+			
	SCE		A^4		A^3B A^2B^2						AB^2C B^4 B^3C B^2C^2 BC^3		

At the upper end of the scale the results are very similar to those for the overall analysis for both years. In both cases SCE (AABB) is above GCE (BB+), this being interpreted in the same way as for Arts students. At the lower end of the scale there is some discrepancy in the position of the lesser qualified GCE students. The reason for this group's high placing in 1973 is that in 1973/74, 23.4 per cent of the SCE qualified entrants to the Science Faculty had their studies officially discontinued and so groups of comparatively well qualified SCE students will appear in the lower part of the scale. In 1971/72, the group of poorly qualified GCE students came lower in the scale which is to be expected as those GCE students who are poorly qualified tend to be entrants to the Science Faculty.

In summary, it appears that there is little difference in the comparative performance of groups of well qualified GCE and SCE entrants to the Arts or the Science faculties. Among the lower qualified students, there are some inconsistencies in the position of the lesser qualified GCE students. However, much of this variation may be explained by the small size of the samples in the categories amalgamated to form this group which results in those groups consisting of students with a wide range of qualifications.

4.4 A SCORING SYSTEM FOR UNIVERSITY PERFORMANCE

The last section of the scoring system considers the problem of assigning quantitative scores to the final degree classifications. There are two primary reasons for assigning such scores: to make decisions regarding the relative ordering of various degree categories with respect to the school qualifications of the students in each category, and to obtain an objective scoring system for use in regression and other statistical analyses.

The two methods described previously in this chapter for use with school qualifications do not permit one to answer both of the above questions as, although they enable one to make decisions regarding the respective ranks of the degree categories, they do not allow one to allocate quantitative scores to the degree categories.

Instead, we will use a method which is adapted from one proposed by Mosteller and Tukey (1977). They argue that if one regards the percentage of the population assigned to each grade as a slice from a logistic distribution, one may assign to each grade the numerical value of the centre of gravity of that slice.

4.4.1 Method

We first describe Mosteller and Tukey's method. There are two important assumptions:

A1: University performance grades may be considered as categories on a continuum which represents a degree of difficulty of success;

A2: An acceptable method of assigning a scoring system is to assume an underlying distribution for degree difficulty in the population.

Mosteller and Tukey use the logistic distribution as this underlying distribution and justify their choice thus: firstly, although many distributions may be suitable, one whose centre of gravity is technically easy to compute would be preferable. In our case they argue further that it should not matter unduly what distribution is used so long as it agrees roughly with our ideas of the distribution of performance in the final degree examination. Mosteller and Tukey describe their choice as being due partially to its attractive shape: "symmetric, with a single mode that is not unduly peaked".

There are three justifications for the use of the logistic distribution in this context. Firstly, as we describe in Chapter 5, the logistic distribution is a good fit to the data when a binary criterion of performance is used. Secondly, Mosteller and Tukey state that for "slices" that are bounded on both sides, there is little difference between a number of similar distributions (eg Normal, Cauchy), so any error is unlikely to be large. Thirdly, we require a distribution that will not allow extreme observations to exert too powerful an influence on the rest of the analysis. For the logistic distribution the 95% limits are (-3.23,3.23) while the 99% limits are (-4.652,4.652), which, in practice, do not influence the results to a great extent.

To demonstrate the technique, we consider initially a dichotomous pass/fail criterion of performance. Figure 4:4 illustrates a case where 20% pass and 80% fail. The centre of gravity of the slice from $0 \rightarrow p$ is expressed as

$$CG(0 \rightarrow p) = \frac{p\ell np + (1-p)\ell n(1-p)}{p} = \frac{\Phi(p)}{p}$$

and from $p \rightarrow 1$ as

$$CG(p \rightarrow 1) = -\frac{p\ell np + (1-p)\ell n(1-p)}{(1-p)} = \frac{-\Phi(p)}{1-p} = \frac{\Phi(1-p)}{1-p} .$$

Therefore for this example CG(pass) = 2.502 and CG(fail) = -0.626 .

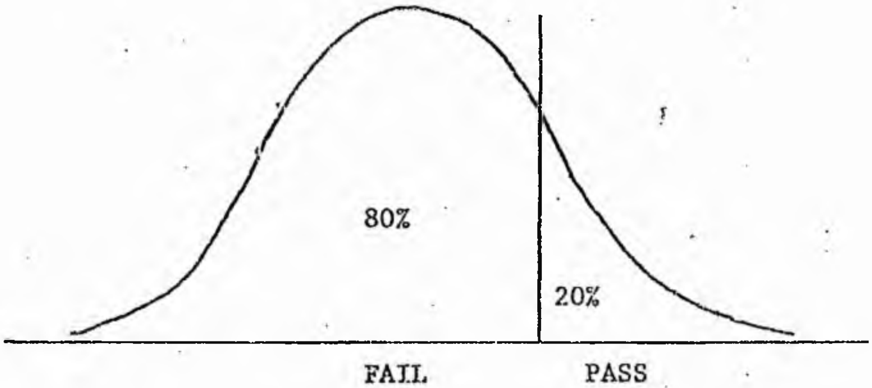


Figure 4:4: Simple example of centres of gravity

In the general case, the centre of gravity for the "slice" of the distribution from p_1 to p_2 is expressed as

$$CG(p_1, p_2) = \frac{\Phi(p) - \Phi(q)}{p - q} ,$$

where $p = prob(X \geq p_1)$, $q = prob(X \geq p_2)$ and $\Phi(p) = p\ell np + (1-p)\ell n(1-p)$, and so, for the case illustrated in Figure 4:5,

CG(A) = 1.21

CG(B) = -0.047

CG(C) = -3.251 .

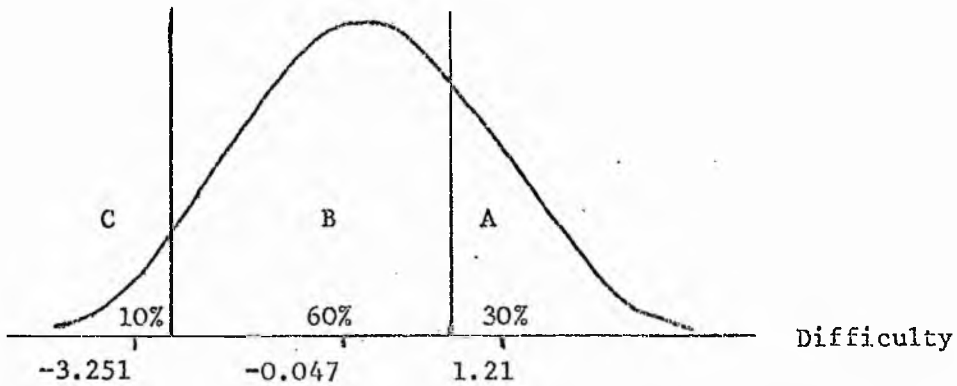


Figure 4:5: Example of centres of gravity for an examination with three possible grades

The above results refer to a situation where the data consist simply of the proportions of students who attain each grade. However, we also wish to utilise information on the entrance qualifications of the students in each final degree category. This is achieved by adopting the following approach:

(1) Calculate the centres of gravity within each degree classification of the slices formed by the proportions of students with each entrance qualification score.

(2) Calculate the mean of these centres of gravity for each final degree classification. This mean weight is assigned to each final degree classification.

Let us consider the structure of the results formed using this technique. Firstly, while the cumulative proportion (p) is less than (1-p) (the first eight slices in Table 4:27), the centres of gravity will be negative. Small proportions at the start of the scale will thus lead to large negative values and vice versa. Therefore, we assign a low weight to a degree classification, with small proportions at the lower end of the scale. Consider the case of a first class honours. In this classification, we might expect there to be few students with low entrance qualifications and would therefore assign a negative weight to a first and, similarly, a positive weight to a fail, say. To facilitate easy interpretation of the scale, it would be desirable for the scale to be in the opposite direction. As the distribution is symmetric this may be achieved very simply by reversing the order in which we calculate the cumulative proportion. Table 4:27 illustrates the calculation of the weight for a lower second based on entrants in 1971 and 1972. In this case the mean weight to be assigned to a 2(ii) is -0.15 .

A second property of this technique concerns the comparability of weights from different samples. If one weight is more positive or negative than another, we usually infer that it has a smaller proportion of its observations in the corresponding tail of the distribution. For example, the weights for a first are more positive than those for a lower second because few poorly qualified students are awarded a first and so the distribution is shifted along the overall distribution of entrance qualifications while there is a wider range of ability among those who are awarded a lower second. This example is illustrated in Figure 4:6.

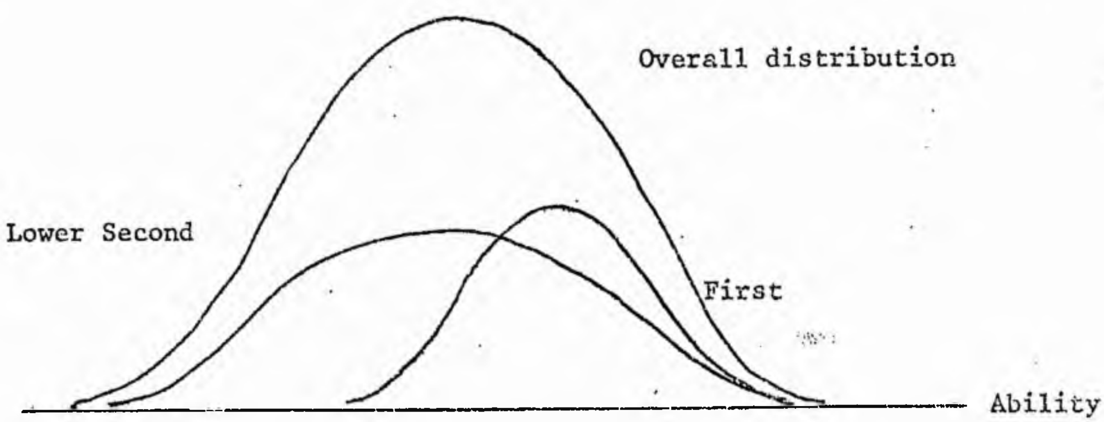


Figure 4:6: Distributions of first and lower second where the first is assigned a larger weight

Table 4:27: Example of the calculation of a degree weight

Entrance score	21	20	17	16	15	14	13	12	11	10	9	8	7	6	5	4
p (in each category)	05	07	02	02	07	09	07	09	07	07	10	06	04	08	06	04
$p = p(X \geq p_1)$	00	05	12	14	16	23	32	39	48	55	62	72	78	82	90	96
$q = p(X \geq p_2)$	05	12	14	16	23	32	39	48	55	62	72	78	82	90	96	100
$\Phi(p)$	0000	-1985	-3669	-4050	-4397	-5393	-6269	-6687	-6923	-6881	-6641	-5930	-5269	-4714	-3251	-1679
$\Phi(q)$	-1985	-3669	-4050	-4397	-5393	-6269	-6687	-6923	-6881	-6641	-5930	-5269	-4714	-3251	-1679	0000
$\Phi(p) - \Phi(q)$	-1985	-1684	-0381	-1877	-0996	-0976	-0418	-0236	0042	0240	0711	0661	0555	1453	1572	1679
$CG = \frac{\Phi(p) - \Phi(q)}{p - q}$	-3.97	-2.4	-1.9	-1.73	-1.42	-0.97	-0.59	-0.33	0.06	0.34	0.7	1.1	1.39	1.83	2.62	2.79

NB 1. Decimal points omitted

2. p_1, p_2 are the upper and lower bounds of each band

4.4.2 Results

The above method was applied to the standardised data described in Section 4.2 . The measure of school performance used was the scoring system derived in Chapter 4. Analyses were performed both for all students and for SCE and GCE students separately.

It could be beneficial to analyse Science and Arts students separately,but this was not done here for two reasons.Firstly,our aim is to compare the school qualifications of students who gain an Upper or Lower Second with those who are awarded an Undivided Second and therefore,as comparatively few Arts students are awarded an Upper or Lower Second it is helpful to analyse all students together as this permits us to consider a large number of students with a "Divided" Second.Secondly,very few students fall into some categories of both school and university performance,and analysing all students together enables us to have more confidence in our results.

Initially, let us consider all entrants: Table 4:28 displays the results for all entrants in 1971 and 1972 and as validation for 1973 entrants also. As very few students were awarded a third class honours in 1973, this degree has been eliminated from the 1973 analyses.

Table 4:28: Logistic standardisation for all students

	First	2(i)	Und 2	2(ii)	Third	Ordinary	Fail
1971/72	1.136	0.13	0.33	-0.15	-0.5	-0.41	-0.61
1973	0.914	0.34	0.44	0.00		-0.75	-0.811
Combined	1.062	0.20	0.36	-0.10	-0.59	-0.52	-0.68

The orderings of the degree classifications are identical for both groups of entrants. There are two results of interest: firstly, the mean centre of gravity for undivided seconds comes above that for both of the other second class categories. This is an indication of the high standard of entrants to the Arts faculty, especially those of GCE qualified students. Secondly, ordinary degrees rank above third class degrees which confirms our expectations that students who take an ordinary might have, as a group, better school qualifications than those who gain a third, as some well-qualified students take an ordinary by choice rather than default.

To aid the elimination of extreme results and thus increase our confidence in our final scale, we use the mean of the results for 1971/72 and 1973. We give the results for 1971/72 a weight of two as they represent two years. These results are displayed in the third row of Table 4:28. The score for a third was calculated by placing it in the same relative position on the combined scale as it held on the 1971/72 scale.

To enable the relationships to be more readily interpretable, it is helpful to transform these results. This transformation is achieved (i) by adding 0.68 to each value, (ii) setting a fail equal to one and (iii) setting the distance between the fail and third categories to one. This gives us the scale displayed in Table 4:29.

Table 4:29: Transformed scale for degree performance (all entrants)

First	Undiv 2	2(i)	2(ii)	Ordinary	Third	Fail
19	12.5	11	7.5	2.7	2	1

There appear to be three "clusters" of grades: ordinaries, thirds and fails are more prevalent among the groups of students with medium to poor school qualifications; second class honours degrees are gained by students with a broad range of entrance qualifications; and finally, first class degrees are awarded almost exclusively to students who had performed to a high standard at school.

These findings are not very surprising. They do, however, illustrate two points: firstly, prediction of good and poor performance at university on the basis of school performance appears to be possible and secondly, among those students who perform poorly at university, there is little difference, on average, between the school qualifications of those who pass and of those who fail. Therefore we have provided some support for the suggestion in Chapter 2 that academic ability is not the sole cause of failure but, rather, a major contributor. We will return to this problem in greater detail in Chapters 5 and 6.

Let us now compare the university scales for SCE and GCE qualified students respectively. The results for SCE students are displayed in Table 4:30. The most striking result is that for SCE students those who fail have, as a group, poorer entrance qualifications than any other group. This is not to suggest that there is a threshold below which any student fails but, rather, the results indicate that there may be a threshold above which very few people fail. Secondly, the entrance qualifications of the group of SCE students who were awarded an undivided second were lower than those who were awarded an upper second. For 1971/72 they are lower than those who gain a lower second but this result is reversed for 1973 entrants. Thirdly, the qualifications of those SCE students who take an ordinary are, as expected, fairly high.

Table 4:30: Weights assigned to degree categories for SCE students

	First	2(i)	Undiv. 2	2(ii)	Third	Ordinary	Fail
1971/72	1.72	1.18	0.43	0.77	0.16	0.31	-0.56
1973	1.5	1.02	0.73	0.58	Not computed	0.34	-0.62
All	1.62	1.12	0.53	0.71	0.16	0.32	-0.58
Transformed	37	32	25	26	20	22	10

The results for GCE students are displayed in Table 4:31. The weight for a fail in 1973 was not calculated as there were only four students whose studies were discontinued.

Table 4:31: Degree classification weights for GCE students

	First	2(i)	Und 2	2(ii)	Third	Ordinary	Fail
1971/72	0.85	0.34	0.54	-0.01	Not computed	-0.49	0.15
1973	0.28	0.10	0.31	-0.87	Not computed	-1.3	Not computed
Combined	0.66	0.15	0.46	-0.29	Not computed	-0.76	(-0.07)
Transformed	4.0	2.9	3.6	2	Not computed	1	Not computed

There are three results of interest: firstly, the weights assigned to a first class honours are less extreme for GCE students than for SCE students. This supports the results of Section 4.3 which suggested that only the very well qualified SCE students were likely to perform very well at university. This does not mean that there will be few very good performances by SCE students as the SCE entrants to St Andrews include many with at least three 'A' grades among their best four Highers.

Secondly, the entrance qualifications of those GCE students who obtained an undivided second were, in general, above those who obtained an upper second, and explains the high weight assigned to an undivided second in the combined GCE and SCE scale.

Thirdly, those GCE students who took an ordinary were, on the whole, poorly qualified. For the 1971 and 1972 entrants, this group had a lower weight than the group who failed. In Chapter 5 we will investigate the hypothesis that, although it is worthless to attempt to predict GCE failure on the basis of school performance, some progress may be made if the definition of failure is changed to include those students awarded a third and those an ordinary.

In summary, this section has considered the problem of assigning weights to university degree classifications. We have constructed scales for SCE and GCE entrants both separately and combined. In the next chapter we will investigate the extent to which these scales do improve the prediction of university performance.

CHAPTER 5

THE PREDICTION OF ACADEMIC PERFORMANCE

In this chapter we will use the scoring systems derived in the previous chapter to predict performance at two stages of university. In the first section we will use binary regression initially to justify our chosen scale and then to construct a model to identify the types of student who are likely to experience most difficulty in completing a degree.

The second section of this chapter will use the final degree awarded to each student as a criterion of performance and will attempt to predict a student's overall result on the basis of school qualifications and of first and second year performance. These analyses do not provide good predictions and suggestions are made regarding the causes of these weaknesses.

5.1 A COMPARISON OF VARIOUS SCORING SYSTEMS

The analyses of chapter four have enabled us to derive a scoring system for SCE and GCE school performance. We must now consider whether this scoring system predicts university performance better than suitable alternative systems.

We therefore require a predictive model of university performance. To construct such a model we must understand the underlying factors contributing to such a model. An exhaustive model of university performance would involve variables such as intellectual ability, examination ability, amount of work and psychological reactions to the examination. Often such variables are unobservable and a resulting model requires the estimation of a number of underlying hypothetical relationships.

It is argued, however, that in the predictive sense for which a model is sought here a comprehensive model such as that described above is unnecessary.

Intellectual ability is the major latent predictor of academic performance both at school and at university. School examinations are the last test of intellectual ability undertaken before the student encounters university assessment and although there will be some "error" both in school and in university assessment (for example due to different markers) our interest is in the relevance of school performance as a predictor of performance. For the purposes of the initial analysis school performance is the only observable variable and so it must be assumed that any underlying errors do not affect the relevance of our model.

In prediction analyses such as this our interest lies in the value of the predictor. We are not interested either in extrapolating this variable to unobservable values, or in its relation to other explanatory variables.

In chapter four we have derived a scoring system for the predictor which gives the optimum relationship with university performance. We must accept the existence of outliers (for example marriage, illness etc.) but for the purposes of this study a basic model is sufficient.

It is also necessary to consider whether predictive capacity should be the only criterion by which we choose a model. We have stated that we require our model to have a practical use in the identification of those students most likely to encounter problems at university. To ease the interpretation of our scale, we will use a scoring system comprised of whole numbers, which will be easily interpretable by any potential user.

In the first section of this chapter we wish to estimate the probability of passing and of failing. A common model for such a purpose is logistic regression, and preliminary analyses suggested that this model was suitable here. We use logistic regression initially to investigate the adequacy of our derived scoring system.

5.1.1 Logistic Regression

The logistic model is widely used in medical and criminological research. Copas and Whiteley (1976) attribute this use to the fact that it allows one to estimate an exact probability of success or failure for a given set of data. The model is fitted to the data thus:

$$\ln\left({}^{p}/1-p\right) = \alpha + \beta X \quad \text{where } p = \text{prob(fail)} \quad . . .(5.1)$$

Berkson (1951) has demonstrated that there is little difference between the logit model (5.1) and the probit model:

$$\Phi^{-1}(p) = \alpha + \beta X$$

where Φ^{-1} is the inverse of the cumulative distribution function for standard normal random variables. We will use the logit model as it is technically easier to fit.

We estimate α, β by maximum likelihood. This technique is well documented (Cox (1970), Ashton (1972)).

Consider the simple model

$$\ln\left({}^{p_i}\!/_{(1-p_i)}\right) = \alpha + \beta X_i \qquad (i=1,\ldots,n) \qquad (5:2)$$

where p_i is the observed probability of failure

X_i is the school qualification score

α,β are unknown constants

Now if $Y_1, \ldots, Y_n$ are a set of independent binary random variables distributed in accordance with (5:2) and $y_1,\ldots,y_n$ are their observed values, the likelihood will contain a factor

$$p_i = \frac{e^{\alpha+\beta X_i}}{1 + e^{\alpha+\beta X_i}} \qquad \text{whenever } y_i = 1$$

and $$1 - p_i = \frac{1}{1 + e^{\alpha+\beta X_i}} \qquad \text{whenever } y_i = 0$$

Hence, the likelihood may be expressed as

$$\ell(\beta) = \frac{\prod_{i=1}^{n} e^{(\alpha+\beta X_i)y_i}}{\prod_{i=1}^{n} (1 + e^{\alpha+\beta X_i})}$$

and the log likelihood as

$$L(\beta) = \alpha \sum_{i=1}^{n} y_i + \beta \sum_{i=1}^{n} X_i y_i - \sum_{i=1}^{n} \ln(1 + e^{\alpha+\beta X_i})$$

Therefore $$\frac{\partial L(\beta)}{\partial\beta} = \sum_{i=1}^{n} X_i y_i - \sum_{i=1}^{n} \frac{X_i\, e^{\alpha+\beta X_i}}{1 + e^{\alpha+\beta X_i}}$$

and $$V(\beta) = E\left[-\frac{\partial^2 L(\beta)}{\partial\beta^2}\right] = \sum_{i=1}^{n} \frac{X_i^2\, e^{\alpha+\beta X_i}}{(1 + e^{\alpha+\beta X_i})^2}$$

The maximum likelihood estimates $\hat{\beta}$ of β satisfy the equation

$$\left[\frac{\partial L(\beta)}{\partial \beta}\right]_{\beta=\hat{\beta}} = 0$$ and those of α follow recursively.

Furthermore, β has an asymptotic covariance matrix, $V^{-1}(\beta)$, which is consistently estimated by $V^{-1}(\hat{\beta})$.

If we are prepared to assume that the $\hat{\beta}$ values are normally distributed confidence limits for $\hat{\beta}$ are readily available. We estimate our confidence interval as

$$\hat{\beta} \pm \kappa_{\varepsilon} \sqrt{V_{11}^{-1}(\hat{\beta})}.$$

However, such assumptions are often erroneous and an alternative method is required for the calculation of the confidence limits. An alternative is to consider the deviations from the value of the likelihood function for values of $\hat{\beta}^*$ not equal to the M.L.E.

i.e. we consider $\{\log L(\hat{\beta}^*) - \log L(\hat{\beta})\ ;\ \hat{\beta}^* \neq \hat{\beta}\}$ which is distributed as $\frac{1}{2}\chi^2_{(1)}$. We find the set of $\hat{\beta}^*$'s such that $(\log L(\hat{\beta}) - \log L(\hat{\beta}^*)) < \frac{1}{2}\chi^2_{(1)}$.

$$\text{i.e.}\quad \{\beta_o;\ L(\hat{\beta}) - L(\beta;\ \beta=\beta_o)\} \leqslant \tfrac{1}{2}\chi^2_{(1)}$$

This enables us to investigate the extent to which an assumption of normality is justified. If the two limits of the confidence region are approximately equidistant from $\hat{\beta}$ then we have some confirmation of the normality of our estimates.

The analyses undertaken in the next two sections were performed using the GLIM(3) Package (Baker and Nelder (1978)).

5.1.2 A justification for the scoring system

Let us consider the question of whether the scoring system derived in chapter four is actually the best predictive scale for St. Andrews. There is no intention that this should be a globally optimum scoring system for all universities. We do require, however, that the techniques should lend themselves to further sets of data from different universities. To test the St. Andrews scoring system, the goodness-of-fit of the St. Andrews scoring system to the logistic model was compared with that of various alternative scoring systems. These are exhibited in Tables 5:1 and 5:3. They were chosen as the most viable alternatives to the derived scale, and are those described in section 4:4.

The linear scales for SCE and GCE performance {SYSTEM 1} are considered because they are the standard scales used in most educational prediction studies. In view of the evidence quoted in section 4:4, deviation from these scales will, at St. Andrew's, lie in the direction of an increased weight to an A grade and therefore we consider the alternatives (ii) and (iii). Both satisfy the constraints of section 4:5. For the analyses of GCE qualified entrants alone, an additional scale: A=10; B=7; C=5; D=3; E=1 is considered.

As we have stated, we use discrete scales. It is possible that a better fit may be obtained to the data by considering continuous axes. However, there are an infinite number of such scales and comparison of all of them would be computationally infeasible. Secondly, Bibby (1979) has reported that, in regression studies, errors made by rounding coefficients to the nearest whole number may not be very large.

The data used in these analyses are the first year performance of all entrants in 1971, 1972 and 1973. To aid the validation of the scoring system and to identify any "maverick" results, each of the three years is considered separately. The criterion of performance used was simply pass or studies discontinued for academic reasons. Those students who left during their first year for non-academic reasons were excluded from this section of the study. The students were discriminated by the sum of the scores on each scale of their best three 'A' levels or best four Highers. The first analysis is of GCE and SCE scales considered separately, and the results are exhibited in Table 5:1. It is important to remember that the rationale for the scales was to construct a joint scoring system for SCE and GCE school qualifications. We will therefore be more interested in the predictive capacity of the combined scoring system. These initial results help us to identify the components influencing the combined model.

Let us consider the overall performance across all the scales for the three different years. There is a "good fit" for all the scales for 1971 and 1973 entrants, but not for 1972 entrants. We may explain this by reference to the data and to the residuals of the respective regressions. These indicate that in 1972 there were a number of outliers - some of which are a result of there being comparatively small numbers in that group. For example, for score 9 on scale (iii), six out of elevent entrants failed - a higher percentage than for scores below nine. Similarly for score 16 on scale (iii) three out of six students failed. Furthermore, observation 4 on each scale is also an outlier as its 100% or 80% failure is underestimated by the respective model. Our confidence in the model is supported, though, by the results for 1971 and 1973 entrants in which the model fits the data very well.

Let us now compare the SCE scales for the three separate years. The levels of significance quoted are those from the χ^2 distribution with κ degrees of freedom. These χ^2 values are distributed as χ^2 only asymptotically and Baker and Nelder (1978) report that rather little is known about the efficiency of the asymptotic approximation for small sets of data. In our example, there may be a tendency for small deviations from the model to be detected, but these deviations will, in practice, not affect the model to any great extent. Accordingly Baker and Nelder (1978) recommend that exact significance levels should perhaps not be used. We display them here for two reasons:

a) We are interested in comparisons between different scoring systems for identical data sets. Generalisations (e.g. $p < .05$) would thus be of little use and

b) certain combinations of 'A' level of Higher qualifications are rare (e.g. SCE : AACC). It will be one of the hallmarks of a good system that it "disguises" maverick observations in numerically small groups while allowing for the inherent variability of performance between different groups of grades. Care must be taken, however, to regard these significance levels as approximations.

SCE QUALIFICATIONS

	1971				1972				1973			
	χ^2	df	sig	$\hat{\beta}$	χ^2	df	sig	$\hat{\beta}$	χ^2	df	sig	$\hat{\beta}$
i) A=3; B=2; C=1.	9.77	7	0.3	-.21	12.4	7	0.12	-.49	7.59	7	0.52	-.45
ii) A=4; B=2; C=1.	11.85	10	0.32	-.17	17.08	8	0.03	-.33	9.23	10	0.55	-.30
iii) A=5; B=2; C=1.	13.76	12	0.35	-.16	11.12	9	0.35	-.22	8.27	10	0.60	-.23
iv) A=8; B=4; C=1.	11.4	11	0.35	-.07	25.97	10	.005	-.15	11.65	13	0.55	-.14

TABLE 5:1 RESULTS OF LOGISTIC REGRESSIONS FOR DIFFERENT SCE SCALES

Note: The model fitted here was $\log ({}^{p}/_{1-p}) = \alpha + \beta x$ where p is the probability of failure and x the school score.

To consider Table 5:1, if we rank the approximate levels of significance for each of the scales across each year, values of Gordon's α may be calculated for the three pairs. They are: $\alpha(71:72) = 2$, $\alpha(72:73) = 2$, $\alpha(71:73) = 4$, where perfect agreement would be represented by a value of four. Furthermore the derived scale (iii) is the "most significant" for each year. In two years the standard linear scale (i) is the least significant, although it was most significant in 1972, the year when the fits were, in general, poor.

To investigate the relevance of including the entrance score in the model we consider the estimates of the coefficients of the entrance scale. These are presented in Table 5.1 also. In every case we reject H_0 : $\beta=0$ against the alternative H_1 : $\beta<0$ at a 5% level of significance. This demonstrates that the prediction of failure is improved significantly by including the entrance score in the model.

There is no possibility of fitting logistic regressions for GCE students alone. The extremely low failure rate of GCE entrants to the University of St. Andrews is shown by Table 5:2. This table indicates that, of these GCE qualified students who entered in October 1971, only six were discontinued after one year and five at a later stage of their career. These figures drop to a total of eight 1972 entrants and six in 1973. It cannot be meaningful to fit a linear regression to such data.

	1971	1972	1973
ARTS MALES	6	0	1
ARTS FEMALES	2	1	4
SCIENCE MALES	2	4	3
SCIENCE FEMALES	1	3	4

TABLE 5:2 NUMBER OF FAILURES BY GCE QUALIFIED STUDENTS 1971-1973

One regression was performed however: on all those who entered between 1971 and 1973 and failed at some stage of their university career. For each of the scales there was no evidence to reject H_o : $\beta=0$, which indicates that academic ability, as measured by school performance, was not the prime cause of failure among GCE entrants.

We must therefore use different criteria to assign weights to GCE grades. Firstly, we require a scale which complements our chosen SCE scale, as this is the main purpose of our scoring system. The scale A=7; B=5; C=4; D=2; E=1 is the only one which complements our chosen SCE scale and also satisfies the criteria described in section 4:3. There is one further subjective criterion: we require a scale that has neither too few nor too many categories. This is also satisfied by scale (iii). Finally, as we shall see in section 5:3, we would like extra weight for a 'B' as well as an 'A' grade on our GCE scale. We may therefore be satisfied with scale (iii) as our GCE scale.

5:1:2 Overall Scoring System

Let us now compare the overall scoring systems. The data are simply those of the preceding two sections combined into one scale for each year.

The results of the regressions are exhibited in Table 5:3. There is an excellent fit for the 1973 and 1971 data, but not so good for 1972. To compare the ranks of the levels of significance for different years we calculate Gordons α's. They are $\alpha(71:72) = 3$, $\alpha(71:73) = 3$, $\alpha(72:73) = 3$ where perfect agreement would be represented by a value of 4. For two years the derived scoring system (iii) is the best fit. In 1971 scale (iv) is the best fit, but in this case there is no reason to reject H_o : β=0, which indicates that including the entrance score in the model is not really relevant. For each of the other scales we reject H_o : β=0 for each year under consideration.

Scoring system	1971 χ^2	1971 df	1971 sig	1971 $\hat{\beta}$	1972 χ^2	1972 df	1972 sig	1972 $\hat{\beta}$	1973 χ^2	1973 df	1973 sig	1973 $\hat{\beta}$
i) GCE A=5; B=4; C=3; D=2; E=1 : SCE A=3; B=2; C=1.	17.95	11	.08	-.26	20.8	10	0.02	-.37	19.53	10	.04	-.36
ii)GCE A=6; B=4; C=3; D=2; E=1 : SCE A=4; B=2; C=1.	19.53	12	.08	-.18	26.51	11	.008	-.27	13.53	12	.35	-.23
iii)GCEA=7; B=5; C=4; D=2; E=1 : SCE A=5; B=2; C=1.	21.55	14	.09	-.13	22.45	15	.10	-.24	9.74	15	.84	-.21
iv)GCE A=11; B=8; C=4; D=2; E=1: SCE A=8; B=4; C=1.	27.09	23	.26	-.06	47.28	22	.005	-.09	29.2	21	.12	-.11

TABLE 5:3 RESULTS OF LOGISTIC REGRESSIONS FOR DIFFERENT SCORING SYSTEMS (ALL ENTRANTS).

NOTE: The model fitted here was $\log(^p/_{1-p}) = \alpha + \beta x$ where p is the probability of failure and x the school score.

Let us consider the choice of the optimum scoring system. We reject system (iv) on two counts. Firstly it is too cumbersome and confusing to be easily interpretable. Secondly, the large number of categories into which observations may fall reduces its use as a predictive instrument. These two reasons also discredit the use of a scoring system with values above those in the system (iv).

The standard linear scoring system (i) has the advantage that, by having the fewest cells, maverick observations may be disguised.

However, it does not, in general, give a better fit than systems (ii) or (iii) nor does it satisfy the constraints of section 4:5. Accordingly system (i) is discounted. It should be noted that other scales such as SCE : A=5, B=3, C=1 were considered. Obviously they will have the same fit as A=3, B=2, C=1 as they preserve the constant difference between the grades. They therefore had little to offer other than increasing the distance between cells in an overall system and were discounted.

We have shown in section 4: 3 that we require an A grade to have extra weight. System (ii) satisfies this criterion but in no case does it fit the data better than scoring system (iii). Furthermore it does not permit us to give extra weight to a GCE 'B' or to give a very large weight to the SCE 'A' grade. Hence we discount system (ii).

Finally we consider the scoring system derived in Chapter 4. It fits the data better than the other scoring systems, has for each year a value of $\hat{\beta}$ which is significantly less than 0 and satisfies the constraints of 4.3 . Therefore the remainder of the analyses of this thesis will adopt this scoring system as a means of comparing SCE and GCE school qualifications.

5.2 A MODEL FOR PREDICTING ACADEMIC FAILURE

We have gone some way towards justifying our scoring system as a comparison of SCE and GCE school qualifications. We must now consider how usefully the scoring system will predict failure at university.

In this section we will firstly introduce various covariates (e.g. Faculty of entry, sex) and will investigate the extent to which these covariates improve the prediction of performance. Two definitions of performance will be used: (a) failure after one year of a university career and (b) failure at any stage of a university career. Secondly an overall model to predict failure will be constructed and its potential use considered. Thirdly, evidence in section 5:2 indicated that the prediction of failure of GCE qualified students was infeasible due to the extremely small number of GCE qualified failures. An alternative definition of GCE "failure" is therefore proposed and the relevance of predictions based on this criterion discussed.

5.2.1 Methods of Analysis

The main technique used in this section will again be logistic regression. Here, though, the emphasis of the discussion will focus on the probabilities of failure predicted by the model rather than on "goodness-of-fit". In addition we will examine the results for possible thresholds of performance below which performance is much worse than above.

The first analyses are of the different subgroups of students formed by the various covariates. The parameter estimates of the model for each equation are compared with those for other subgroups. Those subgroups whose parameter estimates are not found to be significantly different may then be pooled in the overall model.

The covariates used to form the subgroups are not an exhaustive set of such variables. They are used because the review of the literature in Chapter 2 indicated they were likely to discriminate well between different levels of performance and secondly, because they are readily available on each student on entry to St. Andrews. These covariates are sex, faculty of entry and, for SCE qualified students, whether the student had entered direct from Highers or had undertaken a CSYS course.

It is important when constructing a predictive model that the model's parameters should be constant over time. We require, therefore, a formal test of the validity of a set of estimated parameters. If the estimates were based on a maverick year where, for example, new course structures or forms of assessment had caused abnormal failure rates, the estimates would be of little use to any potential users. A formal test is provided as follows (Copas and Whiteley (1976)). Initially we fit the model to the data for the base years which in our case are the combined results for 1971/2. This gives us an estimated probability of failure for each entrance score. Now for the validation year, 1973, suppose there are n entrants of whom r fail. The average estimated probability of failure on the basis of the 1971/2 model may then be calculated for the n entrants. Let this be p_1. If the model parameters are irrelevant to the prediction of failure, we would expect the sum, for the r failures, of their estimated probabilities of failure to equal rp_1 with variance $V_p = \frac{r}{n-1} \sum_{i=1}^{n} (p_i - p_1)^2$ where $\{p_i; i=1,...n\}$ is the estimated probability of failure of individual i among the n entrants in 1973. The observed total for the group of failures is actually T. We test the null hypothesis that the model parameters are irrelevant by using the statistic $t = \frac{T-rp_1}{\sqrt{V_p}}$ and compare this with a t distribution with (r-1)d.f.. In other words we are comparing the distribution of the estimated probabilities of failure of the group of failures in 1973 with that of the entrants as a whole. If we reject the null hypothesis we may conclude that we have some evidence that the estimated probabilities of failure from the 1971/2 data have been validated by the 1973 data.

Table 5:4 illustrates a calculation of this statistic .

5.2.2 Results

The results are reported systematically for each subgroup.

ENTRANCE SCORE	PREDICTED PROB	FAIL	TOTAL ENTRANTS
4	.52	2	2
5	.47	1	5
6	.42	2	6
7	.37	7	13
8	.32	4	12
9	.28	4	6
10	.24	3	14
11	.21	5	18
12	.18	0	5
13	.15	2	9
14	.12	1	14
15	.10	1	5
16	.08	3	7
17	.07	2	8
18	.05	1	1
19	.04	0	8
20	.03	1	9
21	.03	1	8
22	.02	0	15
		40	165

1. The Average predicted probability for the 165 male entrants to the science faculty in 1973 is .19

2. If the prediction were of no validity at all expect the total predicted probability of the 40 failures to be 40 x .19 = 7.6, with standard deviation 0.85. However it is actually 10.17 and therefore we calculate

$$t = \left|\frac{10.17 - 7.6}{0.85}\right| = 3.08$$

which is clearly significant ($p < 0.01$)

TABLE 5:4 FORMAL TEST OF THE 1971/2 PREDICTION FOR MALE SCIENTISTS (FAIL ANYTIME)

The full results are exhibited in Table 5:7 and are illustrated in the graphs 5:1 to 5:25. Many of the analyses are presented for both criteria of performance described above but in some cases there was no difference between the criteria as there was no further failure after first year and these analyses are not presented.

First we compare SCE qualified students who had obtained a good pass in at least one CSYS course with those who entered university with Highers passes alone or poor CSYS passes. The reasons for use of only good CSYS passes have been described in section 4:3:4 which are primarily related to the structure of the CSYS course and the comparative overall performance of those students with various grades in CSYS and those with Highers alone.

The mean Higher performance of those entrants who had taken CSYS is greater than that for the group with Highers alone or poor CSYS grades (CSYS = 14.66; All entrants with Highers alone = 11.96; Highers entrants direct from fifth year = 12.8). We should therefore expect fewer failures among the group who had taken CSYS. The data confirm this; the probability of failure on entry for those SCE students with Highers alone was 0.25, while for those who had successfully undertaken at least one CSYS course it was 0.07.

The regression equations were compared formally using the GLIM3 Package (1978). The "goodness-of-fit" statistic calculated by this package is based on the ratio of the likelihood of the model under question to the likelihood of the full model (which is formed by including n linearly independent structures thus setting the M.L.E.'s equal to the observations themselves). The statistic is $-2\log\frac{lm}{lf}$[1] which, as we have already stated, is approximately χ^2 distributed for the logit model.

[1] lm is the model being fitted, lf is the full model.

Let us consider this statistic. Baker and Nelder (1978) show that if model 1 is the full model, model 2 has r independent parameters and model 3 has t(<r) independent parameters with t nested in r then

$$S_3 - S_2 = -2 \log ({}^{l_3}/{}_{l_2})$$

and is distributed approximately χ^2_{r-t}. Baker and Nelder (1978) state that this enables one to build a table of deviances for a sequence of nested models analogous to sums of squares tables used in analysis of variance.

The results for the comparisons of the predicted equations are shown in Table 5:5. The data areillustrated in Graphs 5:1 to 5:4.[1] The first row is the change in the deviance due to adding the entrance score into the prediction equation. In all four cases this is highly significant. Reference to Table 5:6 demonstrates that the confidence limits for β are approximately equidistant from the $\hat{\beta}$ estimates which is some confirmation of the normality assumptions.

For each of the four analyses we accept the null hypothesis that the slopes of the predicted equations are the same and therefore that it is the poorer qualified students in both Higher and CSYS groups who are experiencing most difficulty. However, we reject the null hypothesis that the intercepts are similar, which demonstrates the greater probability of failure for Highers only entrants.. It is interesting that we are more certain of rejecting the null hypothesis that the intercepts are different when we consider failure at any stage in a university career. This indicates that it is those entrants with Highers alone who are more likely to fail in their second or

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[1] Graphs 5:1 to 5:26 are situated at the end of Chapter 5.

REDUCTION IN SUM OF SQUARES	d.f.	change in devn.	sig.	d.f.	change in dev.	sig.
DUE TO ENTRANCE SCALE	1	60.53	.001	1	38.59	.001
DUE TO DIFFERENT INTERCEPTS	1	19.64	.001	1	3.14	.10
DUE TO DIFFERENT SLOPES	1	.03		1	0.05	
TOTAL CHANGE DUE TO MODEL	3	80.2		3	43.91	
RESIDUAL (FIT OF MODEL)	22	39.4		22	41.78	
TOTAL DEVIATION	25	119.6		25	85.69	
REDUCTION IN SUM OF SQUARES	HIGHERS ONLY v. CSYS ENTRANTS 1971/2, (FAIL ANY TIME)			HIGHERS ONLY v. CSYS ENTRANTS 1971/2 (FAIL FIRST YEAR)		
DUE TO ENTRANCE SCALE	1	39.94	.001	1	33.78	.001
DUE TO DIFFERENT INTERCEPTS	1	11.73	.001	1	5.67	.05
DUE TO DIFFERENT SLOPES	1	0.01		1	0.17	
TOTAL CHANGE DUE TO MODEL	3	61.68		3	39.62	
RESIDUAL (FIT OF MODEL)	21	25.63		21	35.83	
TOTAL DEVIATION	24	87.31		24	75.45	
	HIGHERS ONLY v. CSYS ENTRANTS 1973 (FAIL ANY TIME)			HIGHERS ONLY v. CSYS ENTRANTS 1973 (FAIL FIRST YEAR)		

TABLE 5:5 COMPARISON OF REGRESSIONS FOR THOSE SCE ENTRANTS WHO HAD TAKEN HIGHERS ALONE WITH THOSE WHO HAD UNDERTAKEN A CSYS COURSE

subsequent year at university, perhaps due to their lesser ability as a group as reflected in their performance in the Highers examination.

These analyses confirm clearly the need to include a CSYS component in our SCE scale. Section 4.5 suggested a scale of A=2, B=1 but qualified this by drawing attention to the diverse content and quantity of CSYS work in Scottish schools. Here we have demonstrated that those students who have successfully completed any CSYS courses have a significantly greater probability of completing a degree than do their contemporaries who have Highers alone. To allow for the diverse nature of the amount of CSYS study undertaken by students the remainder of the prediction analyses will truncate the scores of all those SCE qualified students who score above 22 on the combined Higher/CSYS scale to 22.

5.2.2 Sex and Faculty Differences

We have commented in previous chapters that differences in performance between faculties have been observed (UGC (1968), SAPC (1975), Powell (1973), Choppin et al (1973)) both at St. Andrews and elsewhere. Differences between male and female students have not been so consistent. In this section we will consider the performance of students in these categories. Four subgroups will be considered comprising Males and Females in the Arts and Science Faculties.

This section initially considers the performance[1] of SCE students and of all entrants combined. GCE students are not considered alone due to the extremely low numbers of GCE qualified students who fail.

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[1] defined as pass/fail as above.

Graphs 5:5 to 5:22 illustrate the data on logit scales. The respective parameter estimates for each equation are shown in Table 5:6. The graphs and analyses indicate that the model is not really appropriate for entrants to the Faculty of Arts considered for each sex separately. The reasons are similar to those for GCE students, i.e. there are very few failures in the Faculty of Arts. We shall consider this phenomenon fully in chapters six and eight, but in this context they need not affect the relevance of our model. We are interested in predicting failure. We have isolated those subgroups in which there is a high level of failure and in these groups our model is evidently appropriate. The results show that the model, in general, fits the data well. There are better fits for 1973 entrants than for the combined group of 1971 and 1972 entrants. In other words there is a lower residual variability for Science subgroups which are therefore more predictable than the Arts subgroups. Examination of the data helps to explain this last result. Science students are, as a group, less qualified than their Arts counterparts and more fail. In Science, those who fail tend to have poorer entrance qualifications than those who pass, whereas in the Arts Faculty the failures are more uniformly distributed along the entrance scale suggesting that poor performance may be more a result of non-intellectual factors than academic ability.

These inferences are supported by an inspection of the confidence intervals of the $\hat{\beta}$ estimates. For each Science subgroup we reject the null hypothesis that $\beta = 0$ against $H_1 : \beta < 0$ at the 5% level. The results in Arts are less conclusive. There is no reason to reject $H_0 : \beta = 0$ for the estimates for Arts Males for all entrants in 1971 and 1972, and for SCE qualified students in 1973

	χ^2	d.f.	approx. sig.	$\hat{\alpha}$	$\hat{\beta}$	s.e.($\hat{\alpha}$)	s.e.($\hat{\beta}$)	C.I.($\hat{\beta}$)
ALL ENTRANTS								
1971 & 1972 FAIL ANY TIME								
ARTS MALES	28.11	15	.05	-2.23	-.02	1.07	0.07	(-.12, +.08)
SCI. MALES	18.80	17	.40	0.91	-.21	0.38	0.04	(-.28, -.14)
ARTS FEMALES	14.40	15	.50	0.46	-.22	0.71	0.06	(-.34, -.11)
SCI. FEMALES	12.19	17	.80	0.63	-.25	0.78	0.08	(-.36, -.14)
1971 & 1972 FAIL FIRST YEAR								
ARTS MALES	26.30	15	.05	-2.40	-.03	1.19	0.08	(-.13, .08)
SCI. MALES	16.68	17	.60	1.14	-.31	0.51	0.06	(-.42, -.20)
ARTS FEMALES	20.50	15	.15	0.04	-.21	0.82	0.07	(-.33, -.08)
SCI. FEMALES	17.14	17	.50	-1.33	-.12	0.91	0.08	(-.23, -.01)
1973 FAIL ANY TIME								
ARTS MALES	12.91	15	.70	-0.70	-.12	1.19	0.08	(-.24, -.01)
SCI. MALES	10.14	15	.80	0.63	-.14	0.51	0.04	(-.20, -.08)
ARTS FEMALES	13.00	15	.60	0.59	-.24	0.99	0.08	(-.34, -.13)
SCI. FEMALES	11.50	16	.80	1.69	-.29	0.81	0.08	(-.39, -.19)
1973 FAIL FIRST YEAR								
ARTS MALES	12.91	15	.60	-.70	-.12	1.19	0.08	(-.24, -.01)
SCI. MALES	3.53	9	.98	-.07	-.14	0.57	0.05	(-.24, -.08)
ARTS FEMALES	13.00	15	.60	0.59	-.24	0.99	0.08	(-.34, -.13)
SCI. FEMALES	11.54	16	.80	1.05	-.24	0.78	0.08	(-.36, -.11)

TABLE 5:6(i) PARAMETER ESTIMATES FOR SUBGROUP REGRESSIONS

	χ^2	d.f.	approx. sig.	$\hat{\alpha}$	$\hat{\beta}$	s.e.($\hat{\alpha}$)	s.e.($\hat{\beta}$)	C.I.($\hat{\beta}$)
SCOTTISH ENTRANTS ALONE								
1971 & 1972 FAIL ANYTIME								
ARTS MALES	19.70	14	0.15	-1.85	-0.03	1.04	0.07	(-.10, +.04)
SCI. MALES	16.28	17	0.60	1.14	-0.18	0.39	0.04	(-.23, -.14)
ARTS FEMALES	15.57	16	0.60	0.22	-0.19	0.73	0.06	(-.27, -.11)
SCI. FEMALES	8.31	16	0.90	0.96	-0.27	0.89	0.09	(-.38, -.13)
1971 & 1972 FAIL FIRST YEAR								
ARTS MALES	17.40	14	0.20	-2.12	-0.02	1.09	0.07	(-.10, .06)
SCI. MALES	14.82	17	0.80	1.14	-0.27	0.50	0.06	(-.36, -.20)
ARTS FEMALES	18.93	16	0.20	-0.36	-0.16	0.81	0.06	(-.25, -.08)
SCI. FEMALES	10.22	16	0.85	-0.62	-0.16	0.93	0.08	(-.27, -.01)
1973 FAIL ANYTIME								
ARTS MALES	8.96	13	0.80	1.05	-0.17	1.16	0.08	(-.31, +.02)
SCI. MALES	10.14	8	0.65	1.24	-0.17	0.58	0.05	(-.21, -.12)
ARTS FEMALES	14.03	15	0.50	0.78	-0.24	1.04	0.09	(-.46, -.02)
SCI. FEMALES	11.05	14	0.60	1.18	-0.21	0.81	0.09	(-.42, -.01)
1973 FAIL FIRST YEAR								
ARTS MALES	7.47	13	0.80	0.53	-0.20	1.37	0.11	(-.41, +.01)
SCI. MALES	9.12	8	0.40	0.39	-0.14	0.61	0.05	(-.17, -.11)
ARTS FEMALES	13.64	15	0.60	0.33	-0.17	1.04	0.08	(-.34, -.02)
SCI. FEMALES	11.05	14	0.60	1.18	-0.20	0.82	0.09	(-.38, -.02)

TABLE 5:6(ii) PARAMETER ESTIMATES FOR SUBGROUP REGRESSIONS

while for other groups the hypotheses are only marginally accepted.

Most students who have their studies discontinued after a second or subsequent year at university are Science students. Comparing the results for Science students for the two performance criteria (Graphs 5:5 - 5.8, Table 5.6) we observe little difference in the goodness-of-fit of the model to the data and accept the null hypothesis of no difference in the slopes of the predicted equations.

To consider the vectors of the parameter estimates for the subgroups formal tests of the hypotheses of equality of the parameters are displayed in Tables 5:7 and 5:8. They are calculated in the same way as those in Table 5:5. It is immediately obvious that, as expected, the entrance score is a very significant predictor of performance for each of the combined groups. Secondly, the evidence suggests that while the slopes of the regression equations are similar for all groups except male artists, there are a number of significant differences in the intercepts. Examination of the graphs demonstrates that failure is highest among male scientists followed by female scientists and female artists. These results suggest that it will be relevant to include information on a student's sex and faculty of entry in our overall model.

When we consider SCE students alone (Table 5:8; Graphs 5:15 - 5:22) we observe similar results. For 1971/2 entrants male scientists are again more likely to fail, and we also reject the null hypothesis that the slopes of the regression equations are equal for any comparison involving male artists. Results for 1973 entrants are similar.

To test the validity of the parameters obtained from the 1971/2 analyses we use the test described in Table 5:4. The results are displayed in Table 5:9 and demonstrate that for each subgroup except male artists the predictions were significant.

The aim of these analyses was to build a predictive model on the basis of the data set for 1971/2 entrants and to use the 1973 data to test

	CHANGE DUE ENTRANCE SCORE		CHANGE DUE DIFFERENT SLOPES		CHANGE DUE DIFFERENT INTERCEPTS		RESIDUAL	
	χ^2_1	sig	χ^2_1	sig	χ^2_1	sig	$\chi^2 n-4$	n
FAIL YEAR 1 (1971/2 ENTRANTS)								
ARTS (M v F)	12.91	.001	0.01	NS	4.67	.05	42.51	35
SCI. (M v F)	59.44	.001	0.27	NS	5.52	.05	31.14	38
MALE (A v S)	49.63	.001	4.75	.05	7.87	.01	46.9	36
FEMALE (A v S)	32.77	.001	0.11	NS	0.20	NS	26.59	37
ARTS MALE v SCI. FEMALE	11.42	.001	0.01	NS	5.01	.05	40.3	36
ARTS FEMALE v. SCI. MALE	77.61	.001	0.03	NS	5.02	.05	33.24	37
FAIL ANY TIME (1971/2 ENTRANTS)								
ARTS (M v F)	9.01	.01	0.07	NS	2.76	.10	46.79	35
SCI. (M v F)	49.83	.001	3.07	.10	4.23	.05	33.84	38
MALE (A v S)	48.67	.001	7.29	.01	1.00	NS	42.9	36
FEMALE (A v S)	12.99	.001	0.65	NS	0.70	NS	37.63	37
ARTS MALE v SCI. FEMALE	2.24	.15	0.60	NS	0.01	NS	43.44	36
ARTS FEMALE v SCI. MALE	69.21	.001	1.26	NS	0.26	NS	37.17	37

TABLE 5:7(i) TESTS OF HYPOTHESES OF EQUALITY OF REGRESSION PARAMETERS FOR ALL ENTRANTS TO ST. ANDREWS .

	CHANGE DUE ENTRANCE SCORE		CHANGE DUE DIFFERENT SLOPES		CHANGE DUE DIFFERENT INTERCEPTS		RESIDUALS	
	χ^2_1	sig	χ^2_1	sig	χ^2_1	sig	$\chi^2 n-4$	n
<u>FAIL YEAR 1</u> (1973 ENTRANTS)								
ARTS (M v F)	11.83	.001	0.55	NS	0.75	NS	25.91	34
SCI. (M v F)	24.00	.001	3.55	.05	0.90	NS	39.38	38
MALE (A v S)	14.23	.001	0.59	NS	0.40	NS	40.58	36
FEMALE (A v S)	32.48	.001	0.78	NS	0.19	NS	23.86	36
ARTS MALE v SCI. FEMALE	18.10	.001	0.13	NS	1.83	.15	23.87	36
ARTS FEMALE v SCI. MALE	25.19	.001	2.54	.12	0.19	NS	40.57	36
<u>FAIL ANY TIME</u> (1973 ENTRANTS)								
ARTS (M v F)	14.40	.001	0.14	NS	1.34	NS	26.02	34
SCI. (M v F)	23.22	.001	0.02	NS	1.15	NS	38.62	38
MALE (A v S)	19.56	.001	6.35	.02	1.06	NS	39.35	36
FEMALE (A v S)	38.93	.001	0.52	NS	0.13	NS	24.04	36
ARTS MALE v SCI. FEMALE	21.03	.001	0.13	NS	2.44	.10	23.85	36
ARTS FEMALE v SCI. MALE	34.46	.001	10.37	.01	2.21	.15	39.55	36

<u>TABLE 5:7(ii)</u> <u>TESTS OF HYPOTHESES OF EQUALITY OF REGRESSION PARAMETERS FOR ALL ENTRANTS TO ST. ANDREWS</u>

	CHANGE DUE ENTRANCE SCORE	
	X_1^2	sig
FAIL YEAR 1 (1971/2 ENTRANTS)		
ARTS (M v F)	5.04	.05
SCI. (M v F)	44.72	.001
MALE (A v S)	38.14	.001
FEMALE (A v S)	10.95	.01
ARTS MALE v SCI. FEMALE	2.53	.15
ARTS FEMALE v SCI. MALE	54.15	.001
FAIL ANY TIME (1971/2 ENTRANTS)		
ARTS (M v F)	8.85	.01
SCI. (M v F)	51.11	.001
MALE (Av S)	41.05	.001
FEMALE (A v S)	15.56	.001
ARTS MALE v SCI. FEMALE	9.68	.01
ARTS FEMALE v SCI. MALE	61.51	.001

TABLE 5:8(i) TESTS OF HYPOTHESES
PARAMETERS FOR SCE

CHANGE DUE DIFFERENT SLOPES		CHANGE DUE DIFFERENT INTERCEPTS		RESIDUAL	
χ^2_1	sig	χ^2_1	sig	$\chi^2 n-4$	n
2.07	.15	0.03	NS	36.35	35
0.96	NS	3.73	.10	25.04	38
6.63	.01	1.39	NS	32.24	36
0.01	NS	0.17	NS	29.15	37
1.5	NS	0.05	NS	32.24	36
1.39	NS	1.71	NS	33.75	37
2.58	.10	0.16	NS	35.27	35
0.64	NS	6.52	.05	24.6	38
3.43	.10	10.01	.01	35.98	36
0.55	NS	0.01	NS	23.88	37
4.22	.05	0.29	NS	28.01	36
0.01	NS	9.94	.01	31.85	37

OF EQUALITY OF REGRESSION

ENTRANTS TO ST. ANDREWS

	CHANGE DUE ENTRANCE SCORE		CHANGE DUE DIFFERENT SLOPES		CHANGE DUE DIFFERENT INTERCEPTS		RESIDUAL	
	χ^2_1	sig	χ^2_1	sig	χ^2_1	sig	χ^2n-4	n
FAIL YEAR 1 (1973 ENTRANTS)								
ARTS (M v F)	10.30	.001	1.75	.20	0.09	NS	21.19	34
SCI. (M v F)	19.89	.001	0.02	NS	0.73	NS	38.85	38
MALE (A v S)	14.47	.001	0.32	NS	0.14	NS	36.21	36
FEMALE (A v S)	26.94	.001	3.09	.10	0.59	NS	23.79	36
ARTS MALE v SCI. FEMALE	17.01	.001	0.12	NS	0.27	NS	17.62	36
ARTS FEMALE v SCI. MALE	20.43	.001	5.04	.03	0.02	NS	42.34	36
FAIL ANY TIME (1973 ENTRANTS)								
ARTS (M v F)	13.16	.001	5.98	.02	0.03	NS	22.99	34
SCI. (M v F)	25.78	.001	1.14	NS	0.18	NS	30.24	38
MALE (A v S)	22.5	.001	0.34	NS	0.03	NS	36.49	36
FEMALE (A v S)	32.62	.001	2.68	.10	0.49	NS	23.5	36
ARTS MALE v SCI. FEMALE	17.51	.001	1.13	NS	0.40	NS	18.43	36
ARTS FEMALE v SCI. MALE	31.08	.001	12.87	.001	0.18	NS	34.80	36

TABLE 5:8(ii): TESTS OF HYPOTHESES OF EQUALITY OF REGRESSION PARAMETERS FOR SCE ENTRANTS TO ST. ANDREWS.

whether such a model could usefully predict performance in a future year. Therefore the validation presented here is carried out in one direction only and the model discussed in the next paragraph is based on the 1971/2 entrants.

	ARTS MALES	ARTS FEMALES	SCIENCE MALES	SCIENCE FEMALES
ALL ENTRANTS				
FAIL YEAR 1	0.87	3.17	2.58	2.69
FAIL ANY TIME	0.53	3.32	3.09	3.89
SCE ENTRANTS				
FAIL YEAR 1	1.66	2.82	2.14	2.42
FAIL ANY TIME	1.29	3.08	2.99	2.73

TABLE 5:9 T-TESTS TO VALIDATE PARAMETERS OF REGRESSIONS ON 1971/2 ENTRANTS

These analyses have demonstrated that we require a model of performance which comprises other variables than the entrance score alone. Such a model was constructed and the parameter estimates are displayed in Table 5:10. Each of the covariates adds significantly to the prediction of failure, and the prediction for 1971/2 entrants is significant when validated against the 1973 data. Hence our overall estimate of the probability of failure for any entrant is as described in Table 5:10.

Let us now consider the implications of these results for selection policies at St. Andrews. Although some poorly qualified Scottish students are obviously experiencing difficulty in passing our estimated probabilities of failure do not suggest that there should

An estimate of a student's probability of failure on entry to St. Andrews is constructed as follows:

a) Fail first year

		estimate	standard error estimate
$\ln \hat{p}_1/1-\hat{p}_1 = x =$	0.31		.42
	-0.18	x school score	.03
	-1.173	if GCE qualifications	.33
	+0.03	if science	.26
	-0.53	if female	.26

$\therefore \quad \hat{p}_1 = e^x/(1+e^x)$

b) Fail at any time

$\ln \hat{p}_2/1-\hat{p}_2 = y =$	0.39		.35
	-0.17	x school score	.02
	-0.99	if GCE qualifications	.25
	+0.41	if science	.22
	-0.47	if female	.22

$\therefore \quad \hat{p}_2 = e^y/(1+e^y)$

TABLE 5:10 PARAMETER ESTIMATES FOR MODEL TO PREDICT FAILURE (BASED ON 1971/2 ENTRANTS) be an increased "cut-off point" below which applicants are automatically rejected. Those few SCE students whose best four Highers were four 'C's all failed, but in recent years it has become increasingly unlikely that such students would be admitted.

Therefore we require a method of screening entrants such that those most in need may be offered assistance to overcome their initial problems.

In other words, we must investigate the possibility that a threshold exists below which an entrant's probability of failure is much greater than above it. Three criteria are used to decide on the existence of such a threshold. Firstly we consider the residuals of the logistic regressions. If a suitable threshold were to exist we would expect a change of sign in the residuals around that score. The residuals are calculated using the formula $R = \frac{(O - E)}{\sqrt{n_i p_i (1-p_i)}}$ [1] and two main points are manifest. There is a tendency for there to be a change of sign in the region between a score of nine and one of thirteen which is an indication that a threshold may exist. On the other hand, however, there is no one score at which a shift consistently occurs.

The second criterion is that the numbers above and below the threshold criterion should not be too small. For example, one could select a threshold of four. This would subject only eleven students over the three years to scrutiny which is clearly pointless. The definition of "small" in this context must be somewhat subjective and is chosen such that at least one quarter of the entrants should lie above or below the threshold.

The third criterion is that by considering the observed probabilities of failure for each subgroup we want to identify the

---

1. N.B. : $n_i p_i$ is the expected number of failures for score i.

entrance score which maximises the difference in the probability of failure between those above the score and those below. We do this by systematically moving along the entrance scale and observing the change in the respective probabilities of failure as a result of including a certain score in either the upper or the lower group. The results are calculated separately for each year and are displayed in Table 5:11. These show the respective probabilities for the two scores which most satisfied the above criteria: eleven and twelve. For each case the difference in the probability of failure is greater for a score of eleven than for a score of twelve. Thus we consider eleven as a threshold.

The group most at risk are SCE qualified male scientists. For this group $\hat{p}$ = .28 at the threshold. We will therefore define our criterion of 'at risk' as being a student whose estimated probability of failure in first year is greater than or equal to 0.28.

We must now consider the most effective strategy to assist those most 'at risk' to complete their first year successfully. While we have defined a criterion for identifying those students most 'at risk' there is no intention that this should be a rigid guideline and that, for example, students with estimated probabilities of failure above 0.28 should be prohibited from receiving assistance. However, we must consider the cost of a programme of remedial tuition. If extensive extra tuition were to be offered to most or even all students, the cost in terms of time and teaching resources would be high. Furthermore, the evidence suggests that not all students need extensive extra help. Most would benefit from an approach that offered advice on such matters as methods of studying and library use, while extra tuition would be largely unnecessary. An optimum approach, then, would seem to be to recommend to all students well below our threshold, say with an entrance score of less than 9, that they would be well advised to attend a series of remedial tutorials, while those around the threshold could be offered such a programme if they really felt they would benefit from it. These latter students should also be advised to attend an introductory course on the most effective methods of learning at university. The existence of these programmes should be made aware to all students, and care taken to ensure that those students advised to accept extra tuition do not feel inferior in any way.

In chapter six we will see that the first year performance of those entrants below the threshold is, for most subjects, significantly poorer than that of those students above the threshold.

In summary, we have illustrated that the only subgroup who consistently perform differently are the SCE qualified male scientists. We have used all the information available to calculate a predictive model of performance and have constructed a threshold above which the probability of failure is much less than below.

5.2.4 The performance of GCE qualified students

Let us finally consider the performance of GCE students. It has been argued (SARA (1979)) that the ease with which GCE students complete their first year will leave them unprepared for the work that will be required of them in their second year. Table 5:12 shows that

	ENTRANCE SCORE 1971/2				ENTRANCE SCORE 1973			
	≤ 11	> 11	≤ 12	> 12	≤ 11	> 11	≤ 12	> 12
FAIL FIRST YEAR								
ALL ENTRANTS								
AM	.07	.05	.09	.03	.16	.06	.17	.05
AF	.12	.03	.11	.03	.16	.04	.14	.03
SM	.24	.02	.22	.01	.25	.08	.23	.09
SF	.08	.04	.07	.04	.31	.07	.27	.09
SCE ENTRANTS								
AM	.11	.07	.12	.06	.22	.09	.24	.06
AF	.11	.06	.09	.06	.16	.04	.17	.02
SM	.30	.04	.30	.02	.31	.13	.29	.14
SF	.13	.04	.11	.05	.42	.13	.42	.14
FAIL AT ANY TIME								
ALL ENTRANTS								
AM	.09	.06	.11	.05	.16	.06	.16	.05
AF	.17	.04	.16	.04	.25	.05	.17	.06
SM	.32	.09	.31	.08	.39	.14	.36	.15
SF	.19	.04	.17	.04	.35	.04	.30	.09
SCE ENTRANTS								
AM	.13	.07	.14	.06	.25	.06	.25	.10
AF	.17	.06	.15	.06	.18	.06	.18	.03
SM	.41	.13	.39	.12	.46	.12	.43	.19
SF	.23	.04	.21	.05	.44	.05	.42	.11

MEDIAN DIFFERENCE 1971/2 11 : 0.09 12 : 0.08
1973 11 : 0.18 12 : 0.15

TABLE 5 : 11 "THRESHOLD PROBABILITIES" : PROBABILITIES OF FAILURE FOR STUDENTS ABOVE AND BELOW ENTRANCE SCORES 11 AND 12.

although the SCE and GCE failure rates are very similar after first year there is no evidence that GCE students are experiencing more difficulty than their SCE qualified contemporaries.

%	FIRST	2:1	UNDIV. 2nd	2:2	3	ORD.	FAIL, 1st Year	FAIL OTHER	N
SCE	7	16	11	19	3	22	15	7	1131
GCE	11	18	20	18	4	17	5	7	599

TABLE 5:12 FINAL RESULTS FOR ALL ENTRANTS 1971-1973 COMBINED.

Would it then be feasible to lower the entrance qualifications for GCE qualified students thus helping to alleviate some of the problems caused by falling intakes to certain subjects? Such a policy would not be viable if it led merely to an increase in the numbers of GCE students who obtained third class and ordinary degrees. To investigate this question in this section we define "failure" as obtaining a third, an ordinary, or failing.

The results appear in Table 5:13, (Graphs 5:23 - 5:26). The use of this alternative criterion of performance in our model facilitates a much improved fit of the model to the data. For each group, the inclusion of the entrance score in the model added significantly to the prediction. Comparison of the regressions for different faculties and sexes reveals a significant difference between the slopes of the regressions for separate faculties. In the Science Faculty the model is most appropriate as we continue to accept $H_0 : \beta = 0$ for Arts students. The tendency of females to opt for an Ordinary degree

ALL ENTRANTS	χ^2	d.f.	approx. sig	$\hat{\beta}$	C.I. ($\hat{\beta}$)
1971	13.78	13	.40	-.11	(-.17, -.04)
1972	12.61	13	.40	-.04	(-.14, +.06)
1973	11.64	13	.60	-.19	(-.25, -.11)
SCIENCE FACULTY					
1971	12.25	15	.65	-.18	(-.30, -.06)
1972	15.41	14	.40	-.09	(-.19, -.01)
1973	18.45	13	.13	-.16	(-.27, -.05)
ARTS FACULTY					
1971	15.27	10	.10	-.05	(-.17, +.10)
1972	10.43	13	.65	.09	(-.06, +.24)
1973	14.37	13	.35	-.13	(-.24, -.02)
MALE STUDENTS					
1971	20.50	10	.15	-.13	(-.24, -.02)
1972	12.75	15	.65	-.09	(-.21, +.01)
1973	9.78	14	.80	-.13	(-.24, -.02)
FEMALE STUDENTS					
1971	10.75	12	.60	-.11	(-.23, -.01)
1972	18.14	13	.15	-.03	(-.13, +.07)
1973	17.55	13	.20	-.22	(-.34, -.12)

TABLE 5:13 RESULTS OF LOGIT REGRESSIONS FOR GCE STUDENTS WHERE A "PASS" DEFINED AS GAINING AT LEAST A SECOND CLASS HONOURS DEGREE

is reflected by a significant difference in the intercepts of the regressions for different sexes.

In summary, there is evidence that the poorer qualified GCE students do experience some difficulty in successfully completing a "good" degree, especially in the Science Faculty. There is therefore little justification for admitting comparatively poorly qualified GCE students merely to maintain the numbers of students entering the university.

5.3 PERFORMANCE THROUGHOUT UNIVERSITY

In this section we will investigate the association between school qualifications and a student's performance over the whole of his university career. We will use three criteria of performance: first year and second year passes will be measured by the number of rank certificates awarded to each student; and final degree performance as measured by the class of degree awarded to each student.

The main tool of the analyses here will be regression. Firstly, to gauge the association between school performance and the final degree awarded to each student we will consider the simple linear regression of university performance on school performance. We have discussed some of the drawbacks of such an approach in chapter 3. One of the main drawbacks was the subjectivity with which values have been assigned to various categories in previous analyses. In this thesis we have attempted to overcome these drawbacks by deriving scoring systems for grades. Here we will use those of chapter four together with scales for first and second year performance.

To consider the relevance of performance at each stage of university as a predictor of final degree performance we will use a path analysis approach to predict future performance at each stage of university. We will see that if first and second year performance is measured only by the grades awarded to each student, the variability among successful students will be small and prediction will thus be affected.

5.3.1 The Association between school qualifications and final university performance

Let us first consider the relationship between school and university performance for all students and for SCE and GCE qualified students separately. The variables in the analyses were each assigned values according to the scoring systems derived in chapter four. The results are displayed in Table 5:14 and provide evidence of three main points.

Firstly, for each of the regressions the coefficient of the respective scoring system is significant, which indicates that school qualification is, indeed, a relevant predictor of the final degree awarded to the student. Secondly, the association between school and university performance is higher for SCE qualified students than for their GCE counterparts. There are two possible explanations for this: GCE students have as a group less variability in their entrance qualifications and secondly there is less variability in the final degree performance of GCE qualified students. As we observed in the previous section, many fewer GCE than SCE students have their studies officially discontinued and furthermore, more GCE students enter the Arts Faculty

	$\hat{\alpha}$	$\hat{\beta}$	$s.e(\hat{\beta})$	R^2	F	STANDARDISED REGN. COEFFICIENT
EACH STUDENT						
1971	23.14	3.44	0.44	.14	79.6	0.37
1972	29.56	3.60	0.46	.11	59.8	0.32
1973	24.60	4.51	0.43	.19	96.3	0.46
ALL STUDENTS	22.9	3.99	0.26	.14	229.6	0.37
SCE STUDENTS						
1971	22.38	4.01	0.51	.17	61.5	0.41
1972	30.90	3.60	0.34	.12	47.4	0.52
1973	1.19	0.47	0.05	.24	78.7	0.49
ALL STUDENTS	22.87	4.06	0.31	.17	179.6	0.41
GCE STUDENTS						
1971	15.45	4.67	0.98	.11	22.5	0.33
1972	27.90	3.68	1.06	.07	12.0	0.26
1973	-11.60	6.50	0.46	.21	45.6	0.46
ALL STUDENTS	10.73	4.94	0.57	.13	73.1	0.35

TABLE 5:14 SUMMARY OF REGRESSIONS OF UNIVERSITY PERFORMANCE ON SCHOOL PERFORMANCE

	NUMBER OF 'A' GRADES	NUMBER OF 'B' GRADES	NUMBER OF 'C' GRADES	CSYS OR NOT	NUMBER OF HIGHERS
SCE STUDENTS	.37	-.09	-.26	.21	.21
	NUMBER OF: 'A' GRADES	'B' GRADES	'C' GRADES	'D' GRADES	'E' GRADES
GCE STUDENTS	.34	.03	.11	-.20	-.16
	NUMBER OF: A LEVELS				
	0.00				

TABLE 5:15 PRODUCT MOMENT CORRELATIONS BETWEEN UNIVERSITY PERFORMANCE AND SOME CRITERIA OF SCHOOL PERFORMANCE

than the Science Faculty and, once there, are more likely to be awarded an undivided second than any other degree.

Thirdly, although the proportion of the variation in performance explained is not very high, the use of the scoring system for university has improved the level of the prediction. There are many reasons why we are unable to explain more of the variation, but an important factor is that although we may improve the prediction by our scales we may not completely overcome the restriction that our scales are based on grades alone and will thus lack some sensitivity. To demonstrate the value of our scale we compare them with some of the other common criteria of school performance. Table 5:15 displays the correlations between university performance, as represented by our scoring system, and a number of predictors such as number of school examination passes, number of 'A' grades or whether SCE students had taken CSYS or not. The results demonstrate that the number of A grades a student has is associated with the type of degree they are awarded but that the number of B or lesser grades is not so relevant. Similarly, the inevitable homogeneity within the number of school examination passes obtained by each student reduces that criterion's effectiveness as a predictor of the final degree awarded to each student.

In summary, we have demonstrated that our school scoring system is a relevant predictor of the final degree, but that it is evident that other factors also account for much of the variation in performance.

5.3.2 Prediction using first and second year performance

In this section we consider performance in first and second year, both as dependent variables and as predictors of final degree performance. To use these variables in regression equations it was necessary to assign weights to the grades awarded to students in their first and second year subjects.

The method used to adopt scoring systems of first and second year performance was the adaptation of Mosteller and Tukey's (1978) logistic standardisation developed in chapter 4 for university performance. To limit the number of categories into which students may fall so that we may make confident inferences of the proportions being awarded each final degree, the following categorisations were used. For first year performance, the students were divided into seven categories: failed three subjects, failed two subjects, failed one subject, passed three subjects, one exemption, two exemptions, three exemptions. For the purposes of this categorisation an exemption was defined as all those who were exempt from taking the degree examination and/or were awarded a rank certificate in the subject. The values assigned to these categories are displayed in Table 5:16.

For second year performance, five categories were used. They related only to the second year subjects taken by the students, and ranged from two failures to two rank certificates. The values for all students, for SCE students alone and for GCE students alone are found in Table 5:16.

A restriction of this approach is that we are losing a large amount of information by considering grades alone rather than using the marks awarded to each student in a subject. Unfortunately such marks are not held centrally in the Arts faculty. In chapter 8 we will argue that student records should contain greater details of

FIRST YEAR PEFORMANCE	1.	10	FAIL AT LEAST TWO SUBJECTS
	2.	20	FAIL ONE SUBJECT, PASS OTHER TWO AT JUNE
	3.	28	PASS THREE SUBJECTS AT JUNE
	4.	31	ONE RANK CERTIFICATE
	5.	36	TWO RANK CERTIFICATES
	6.	38	THREE RANK CERTIFICATES
SECOND YEAR PERFORMANCE	1.	10	AT LEAST ONE FAIL
	2.	20	TWO PASSES
	3.	28	ONE RANK CERTIFICATE
	4.	37	TWO RANK CERTIFICATES

TABLE 5:16 VALUES ASSIGNED TO DIFFERENT FIRST AND SECOND YEAR PERFORMANCE BANDS

Note: In the Arts Faculty students in their second year take three subjects - two second year (or special) subjects and one first year (or general) subject. Only those results obtained by the students in their "special" subjects are taken into consideration here.

each student's performance at university, but in this section we must accept that our level of prediction will be affected. Secondly, and more importantly, when we use first and second year performance as predictors of the final degree awarded to each student we are required to leave out of our analysis those students who failed at the end of first or second year. The reason is that it makes no sense to attempt to predict the expected final degree to be awarded to a student whose studies were discontinued after his first year at the university. However it is the students who perform poorly who represent much of the variation in the first and second year performance of the population. In other words the early university performance of those students who gain a degree tend to be very homogeneous. Most students who are accepted onto a honours course will have been awarded a rank certificate in that subject in their second year.

Therefore we might expect that the association between school and final degree performance will be greater than that between performance in first or second year and final degree performance. This expectation is proved as is demonstrated by the results displayed in Table 5:17, which displays the regression coefficients for three regression analyses: first year performance on school score; second year performance on school score and first year performance; and final degree performance on first year, second year and school score. The β coefficients are standardised such that the dependent and independent variables have unit variance (Nie et al (1975)). The values of R^2 displayed to the right of Tabl 5:17 are those for the three regressions, the value in brackets being the contribution of the

	ENTRANCE SCORE (β_1)	FIRST YEAR PERFORMANCE (β_2)	SECOND YEAR PERFORMANCE (β_3)	R^2
1971				
DEPENDENT VARIABLE				
FIRST YEAR	.03			.01
SECOND YEAR	.13	.31*		.11 (.02)
FINAL DEGREE	.31*	.11*	.09	.14 (.10)
1972				
FIRST YEAR	.07			.01
SECOND YEAR	-.03	-.07		.08 (.01)
FINAL DEGREE	.22	-.07	-.01	.05 (.05)
1973				
FIRST YEAR	.37*			.14
SECOND YEAR	.15*	.12*		.12 (.06)
FINAL DEGREE	.28*	.13	.10	.18 (.14)

TABLE 5:17 REGRESSIONS OF UNIVERSITY PERFORMANCE ON SCHOOL PERFORMANCE AND PRIOR UNIVERSITY PERFORMANCE FOR ALL ENTRANTS IN 1971, 1972 AND 1973.

N.B. 1. * indicates that the unstandardised coefficient is significant at a 5% level.

school score to this value of R^2.

The results in Tables 5:17 and 5:18[1] are those for all students, for SCE students alone and for GCE students alone. There are three main features of these results. Firstly, the omission of those students whose studies were discontinued contributes to a lowering of the level of prediction for each variable. Secondly, for each set of students, the coefficient of the school score in the regression with final degree performance is significant, while there are no other consistent significant relationships. The relationships between final degree performance and first and second year performance are tenuous. We shall demonstrate in chapter 6 that when the actual marks are available, the correlation between school and first year performance is fairly high, and this again provides some confirmation that our low associations are partially a consequence of the crudeness of our scales of first and second year performance.

A further drawback of the above approach is that it assumes that results in different subjects are directly comparable and that good degrees are equally likely in different subjects. In an attempt to overcome this flaw, Tables 5:19 to 5:21 display the results of regressions for students who gained degrees in six groups of cognate subjects. These groups are physical and chemical sciences; mathematics; biological sciences; languages; arts and social sciences. There are a number of inter subject differences. For both SCE and GCE students the subjects from the Faculty of Science are more predictable than those from the Faculty of Arts. A possible explanation is that a student in the Faculty of Science is more likely to be awarded a first class degree.

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[1] Tables 5:18 - 5:21 are situated at the end of the chapter.

The amount of variation explained by the regressions was higher for SCE students than for GCE students, and is especially high in Mathematics, a fact which we will discuss in greater detail in chapter six.

There is no relationship between final degree performance in the social sciences and previous academic performance. These subjects: psychology, economics and geography are subjects which will be new to many students studying them at university or are likely to be taught in a different manner from school teaching. It is not surprising therefore that the relationships are so tenuous.

Finally, the lower levels of prediction in the Arts subjects reflects the structure of some Arts degrees who award "undivided second". Our scoring system has no way of discriminating between a "good second" and a poor one.

In summary, these regressions have demonstrated that school performance is a good predictor of final degree performance, but that there will always be a tendency for poor levels of prediction when information is available only on the grades awarded to students, and not on the actual marks attained. Prediction is better in the Science subjects which replicates the results of the first half of this chapter which provided us with a method for estimating the probability of success of a new entrant.

SCE STUDENTS	ENTRANCE SCORE (β_1)	FIRST YEAR PERFORMANCE (β_2)	SECOND YEAR PERFORMANCE (β_3)	R^2
1971				
FIRST YEAR	.05			.01
SECOND YEAR	.20*	.16		.09 (.05)
FINAL DEGREE	.39*	.14	.05	.19 (.16)
1972				
FIRST YEAR	.03			.03
SECOND YEAR	.01	.02		.03 (.01)
FINAL DEGREE	.30*	.14	-.03	.11 (.11)
1973				
FIRST YEAR	.08			.01
SECOND YEAR	.22*	.14		.11 (.06)
FINAL DEGREE	.38*	.12	.00	.17 (.14)
GCE STUDENTS				
1971				
FIRST YEAR	.01			.01
SECOND YEAR	.17*	.16*		.08 (.03)
FINAL DEGREE	.37*	.07	.09	.17 (.13)
1972				
FIRST YEAR	.01			.01
SECOND YEAR	-.02	.13		.03 (.01)
FINAL DEGREE	.22*	.02	.01	.04 (.04)
1973				
FIRST YEAR	.27*			.07
SECOND YEAR	.08	.46*		.21 (.07)
FINAL DEGREE	.37*	.27*	.06	.29 (.15)

TABLE 5:18 REGRESSIONS OF UNIVERSITY PERFORMANCE ON SCHOOL PERFORMANCE AND PRIOR UNIVERSITY PERFORMANCE FOR SCE AND GCE STUDENTS RESPECTIVELY.

N.B. 1. * indicates that the unstandardised coefficient is significant at a 5% level.

ALL ENTRANTS 1971-1973	ENTRANCE SCORE (β_1)	FIRST YEAR PERFORMANCE (β_2)	SECOND YEAR PERFORMANCE (β_3)	R^2
PHYSICS/CHEMISTRY				
FIRST YEAR	.10			.01
SECOND YEAR	.40*	-.07		.16 (.15)
FINAL DEGREE	.44*	-.04	-.01	.19 (.18)
MATHEMATICS				
FIRST YEAR	.23			.01
SECOND YEAR	.32	.04		.03 (.02)
FINAL DEGREE	.54*	.01	.14	.16 (.15)
BIOLOGICAL SCIENCES				
FIRST YEAR	-.05			.01
SECOND YEAR	.22*	.25*		.10 (.04)
FINAL DEGREE	.36*	-.01	.14	.17 (.15)
SOCIAL SCIENCES				
FIRST YEAR	.11			.01
SECOND YEAR	.03	.20*		.04 (.01)
FINAL DEGREE	.11	.07	.11	.03 (.02)
LANGUAGES				
FIRST YEAR	.40*			.16
SECOND YEAR	-.01	.20*		.03 (.01)
FINAL DEGREE	.20*	.07	.08	.04 (.03)
ARTS				
FIRST YEAR	.15*			.02
SECOND YEAR	-.05	.18*		.03 (.01)
FINAL DEGREE	.16*	.20*	.06	.08 (.04)

TABLE 5:19 REGRESSIONS OF UNIVERSITY PERFORMANCE ON PREVIOUS ACADEMIC PERFORMANCE FOR VARIOUS SUBJECT GROUPINGS FOR ALL ENTRANTS IN 1971-1973 TAKING AN HONOURS DEGREE IN THAT SUBJECT GROUP

N.B. 1. * indicates that the unstandardised coefficient is significant at a 5% level.

DEPENDENT VARIABLE	ENTRANCE SCORE (β_1)	FIRST YEAR PERFORMANCE (β_2)	SECOND YEAR PERFORMANCE (β_3)	R^2
PHYSICS/CHEMISTRY				
FIRST YEAR	.31*			.10
SECOND YEAR	.33*	.03		.10 (.10)
FINAL DEGREE	.64*	-.11	-.13	.35 (.32)
MATHEMATICS				
FIRST YEAR	.13			.02
SECOND YEAR	.46*	.10		.13 (.12)
FINAL DEGREE	.67*	.01	.08	.13 (.11)
BIOLOGICAL SCIENCES				
FIRST YEAR	-.13			.02
SECOND YEAR	.36*	.20		.23 (.19)
FINAL DEGREE	.31*	-.07	.07	.40 (.35)
SOCIAL SCIENCES				
FIRST YEAR	.12			.02
SECOND YEAR	.13	.23*		.08 (.03)
FINAL DEGREE	.14	.17	.02	.06 (.03)
LANGUAGES				
FIRST YEAR	.23*			.05
SECOND YEAR	.09	.08		.02 (.01)
FINAL DEGREE	.43*	-.08	-.05	.17 (.16)
ARTS				
FIRST YEAR	.22*			.05
SECOND YEAR	-.09	.19		.04 (.01)
FINAL DEGREE	.27*	.07	.25*	.18 (.11)

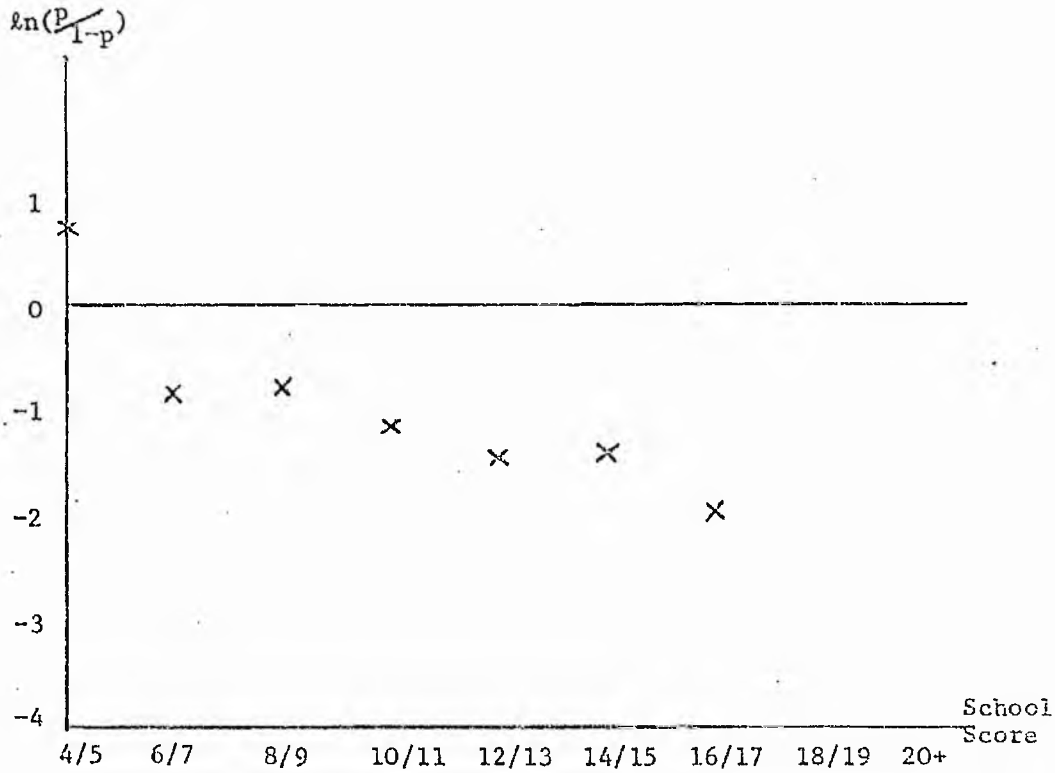
TABLE 5:20 REGRESSIONS OF UNIVERSITY PERFORMANCE ON PREVIOUS ACADEMIC PERFORMANCE FOR VARIOUS SUBJECT GROUPINGS FOR ALL GCE ENTRANTS IN 1971-1973 TAKING AN HONOURS DEGREE IN THAT SUBJECT GROUP

N.B. * indicates that the unstandardised coefficient is significant at a 5% level.

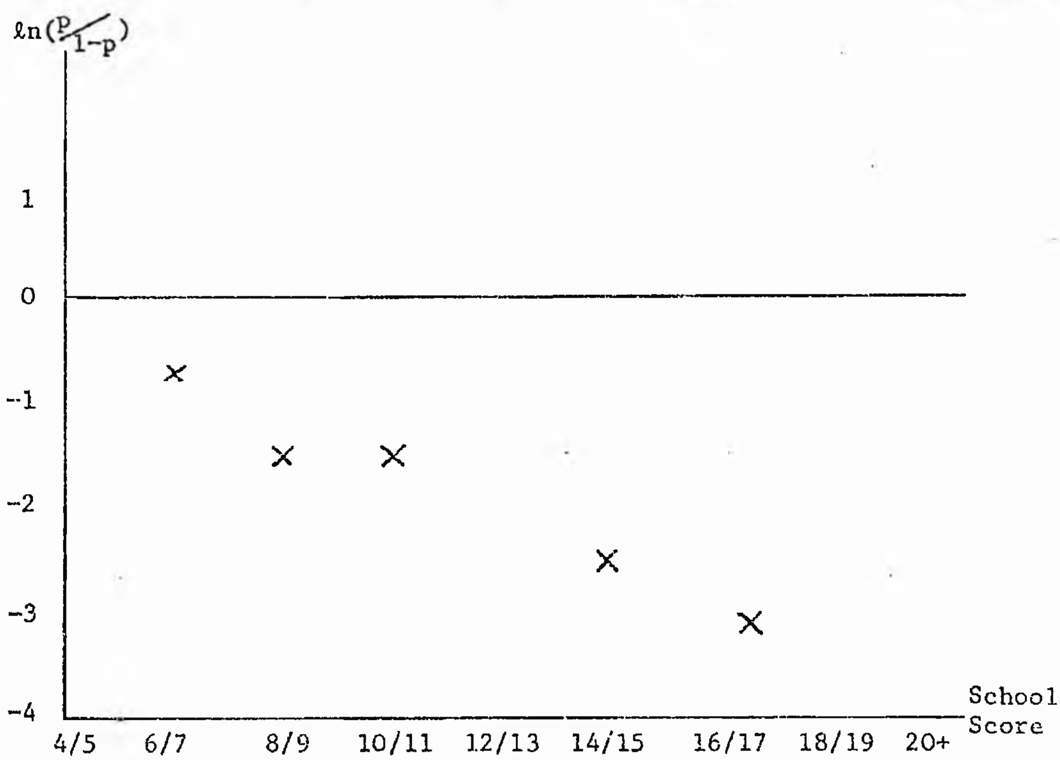
DEPENDENT VARIABLE	ENTRANCE SCORE (β_1)	FIRST YEAR PERFORMANCE (β_2)	SECOND YEAR PERFORMANCE (β_3)	R^2
PHYSICS/CHEMISTRY				
FIRST YEAR	.24*			.05
SECOND YEAR	.30*	.46*		.37 (.16)
FINAL DEGREE	.27*	.17	-.10	.18 (.15)
MATHEMATICS				
FIRST YEAR	.01			.01
SECOND YEAR	.19	.12		.05 (.04)
FINAL DEGREE	.46*	.07	.15	.29 (.24)
BIOLOGICAL SCIENCES				
FIRST YEAR	.06			.01
SECOND YEAR	.32*	.45*		.32 (.12)
FINAL DEGREE	.31*	.04	.05	.13 (.10)
SOCIAL SCIENCES				
FIRST YEAR	.12			.13
SECOND YEAR	.11	.21		.06 (.04)
FINAL DEGREE	.32*	.06	.08	.08 (.06)
LANGUAGES				
FIRST YEAR	.39*			.16
SECOND YEAR	-.08	.20*		.04 (.01)
FINAL DEGREE	.21*	.06	-.05	.04 (.03)
ARTS				
FIRST YEAR	.39*			.16
SECOND YEAR	-.08	.20		.04 (.00)
FINAL DEGREE	.22*	-.05	-.06	.05 (.03)

TABLE 5:21 REGRESSIONS OF UNIVERSITY PERFORMANCE ON PREVIOUS ACADEMIC PERFORMANCE FOR VARIOUS SUBJECT GROUPINGS FOR ALL SCE ENTRANTS IN 1971-1973 TAKING AN HONOURS DEGREE IN THAT SUBJECT GROUP

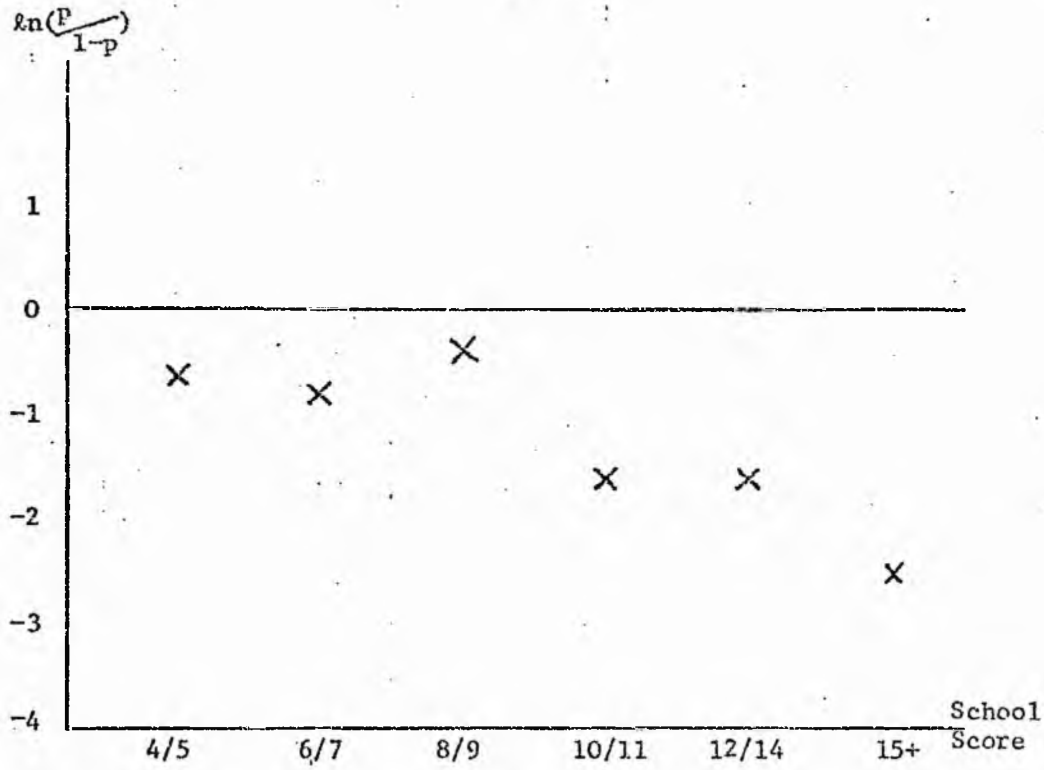
N.B. *indicates that the unstandardised coefficient is significant at a 5% level.



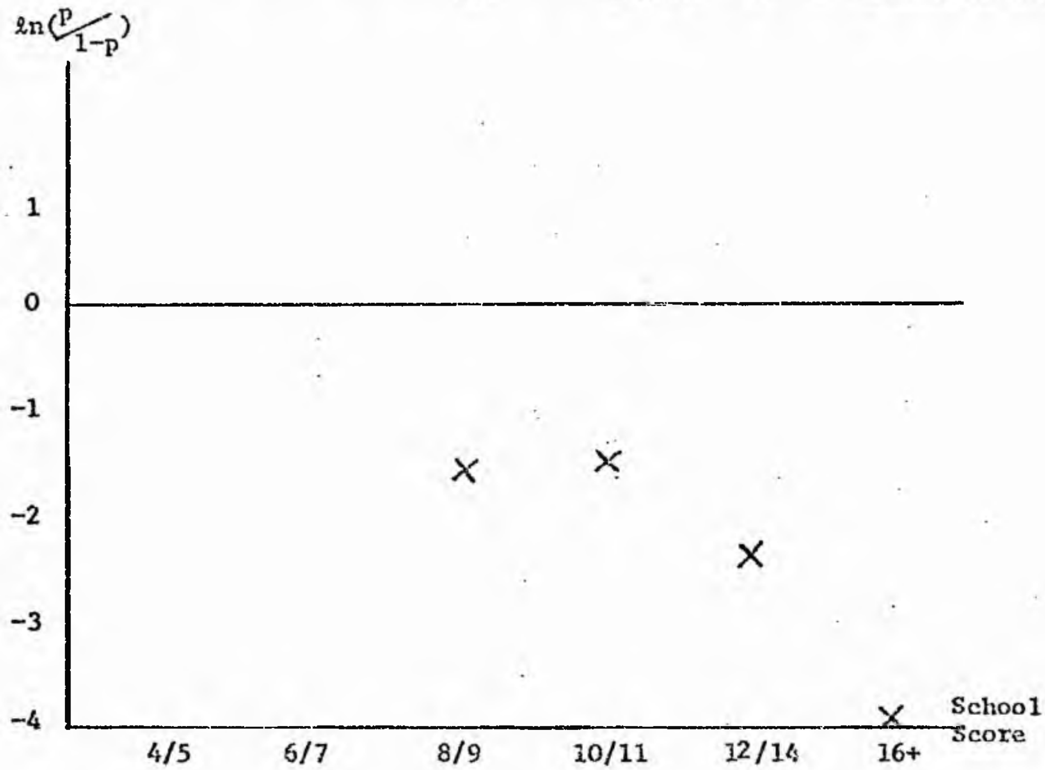
GRAPH 5:1 1971/72 ENTRANTS : SCE (HIGHERS ONLY)



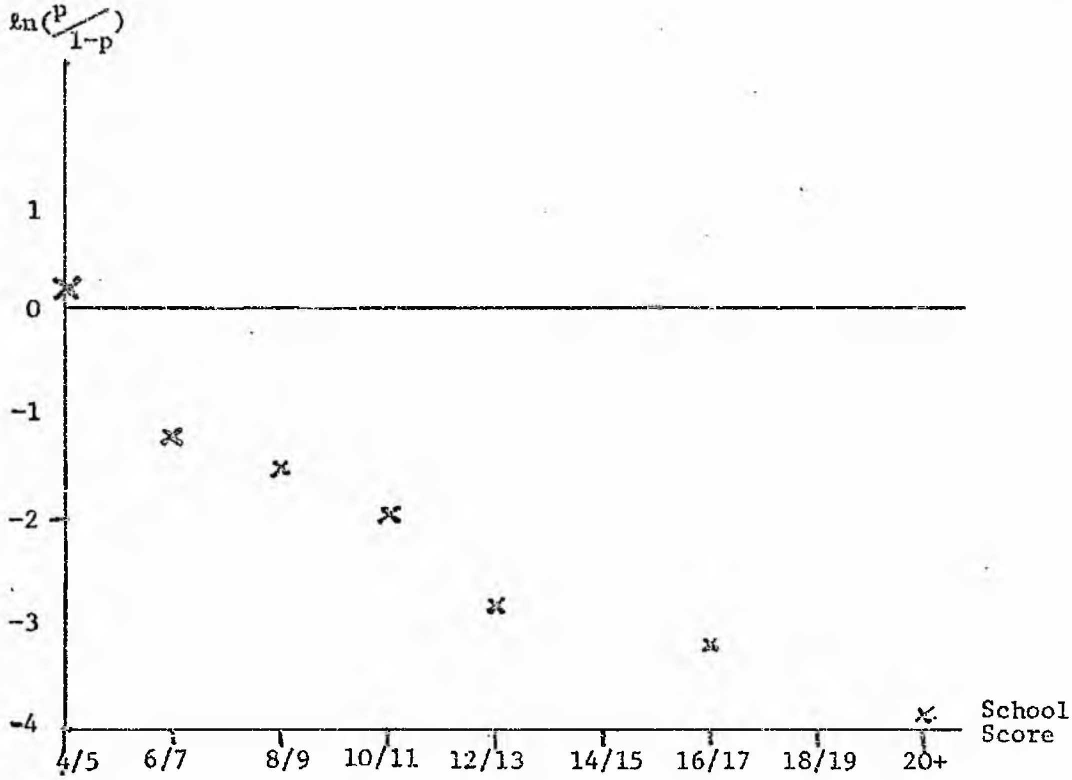
GRAPH 5:2 1971/72 ENTRANTS : SCE WITH SYS



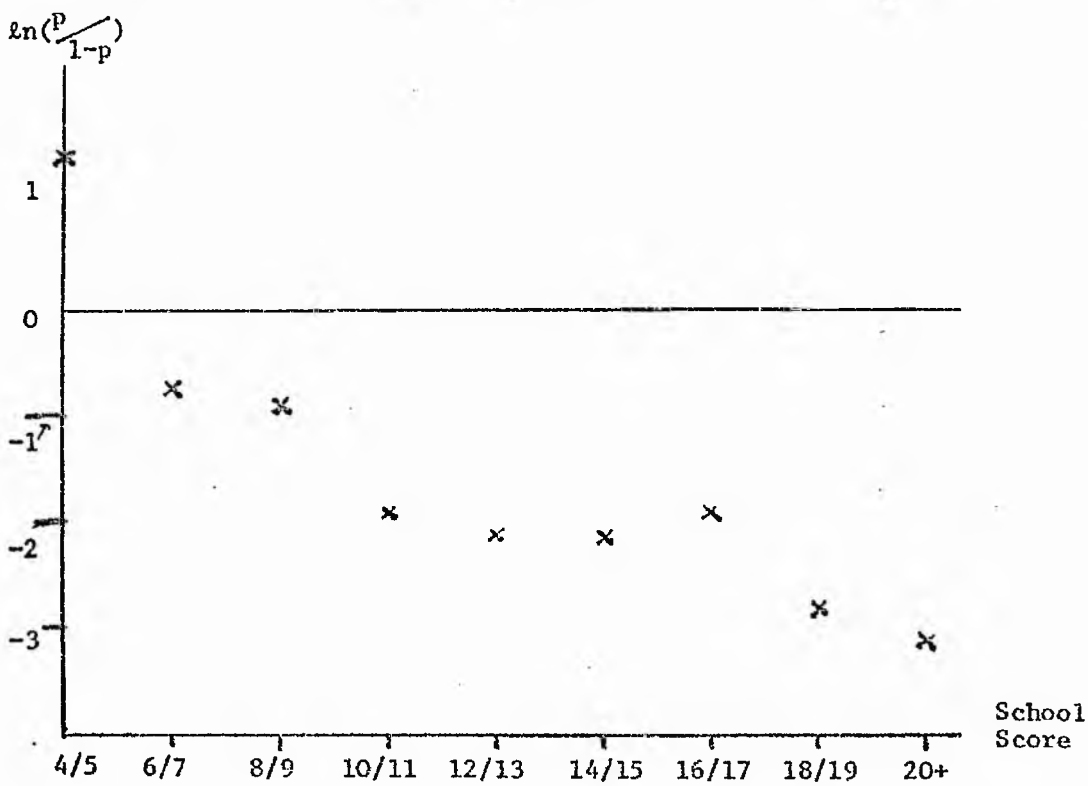
GRAPH 5:3 1973 SCE ENTRANTS (HIGHERS ONLY)



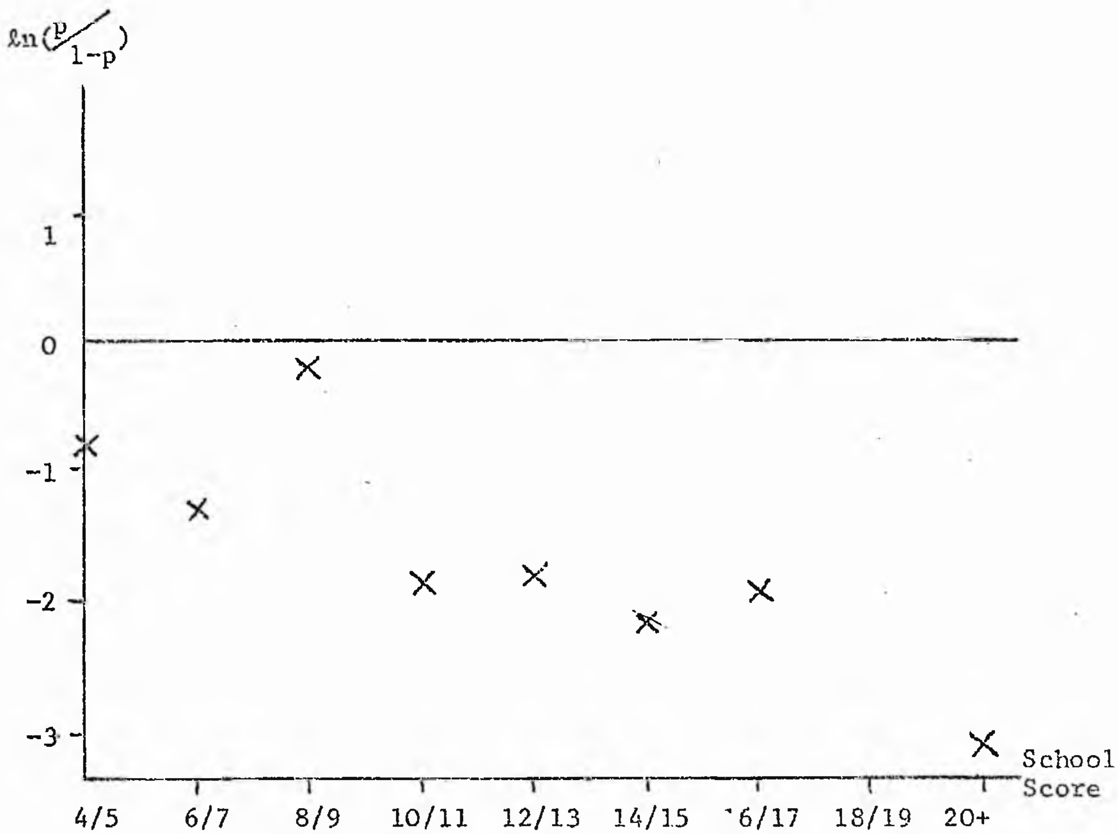
GRAPH 5:4 SCE ENTRANTS (CSYS TAKEN)



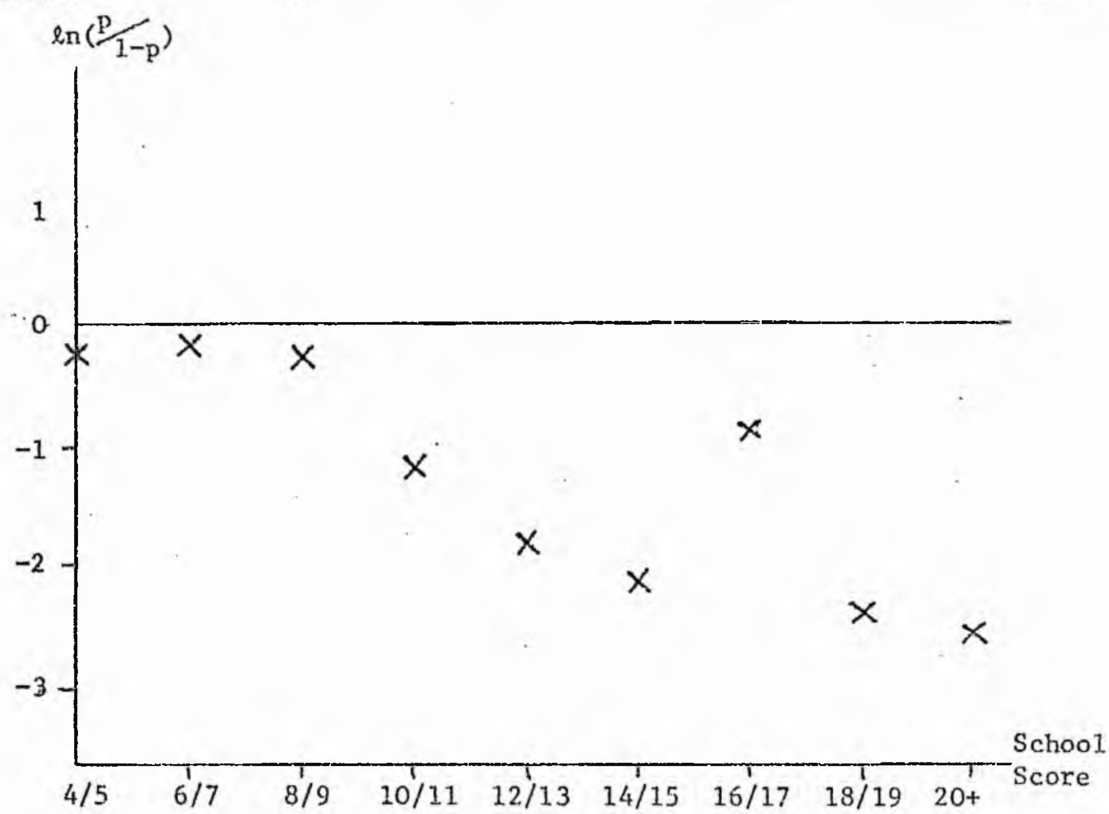
GRAPH 5:5 1971/1972 ENTRANTS : MALE SCIENCE (FAIL YEAR 1)



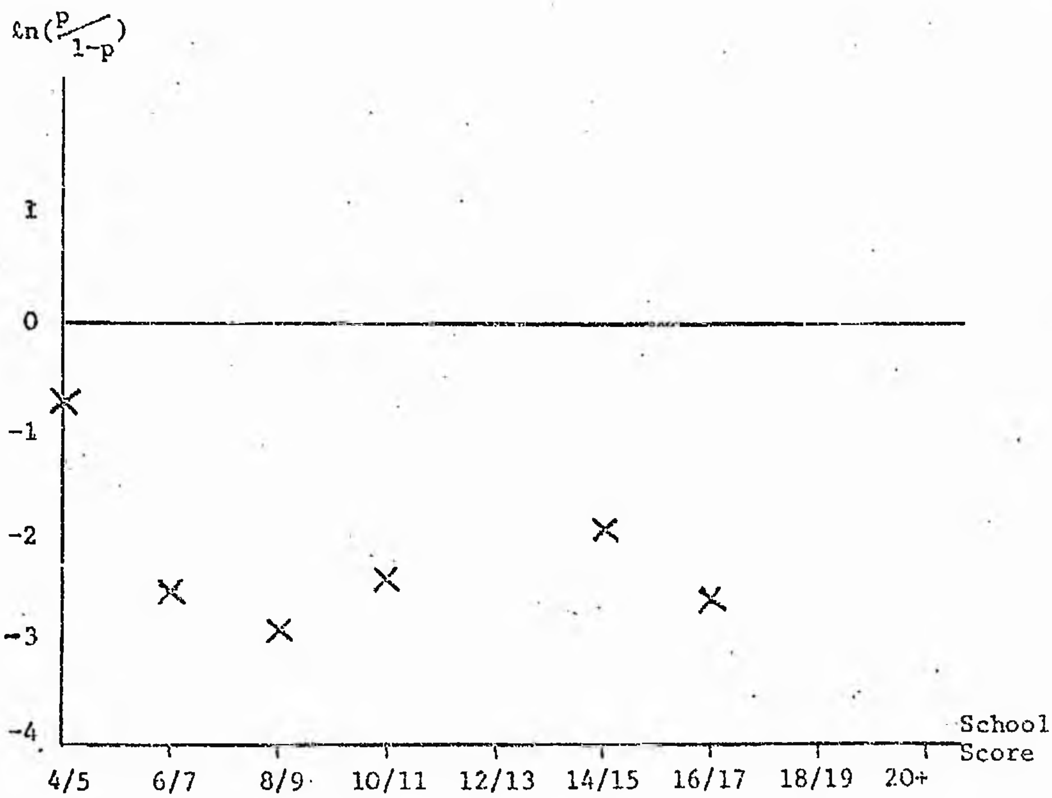
GRAPH 5:6 1971/1972 ENTRANTS : MALE SCIENCE (FAIL AT SOME STAGE OF UNIVERSITY CAREER)



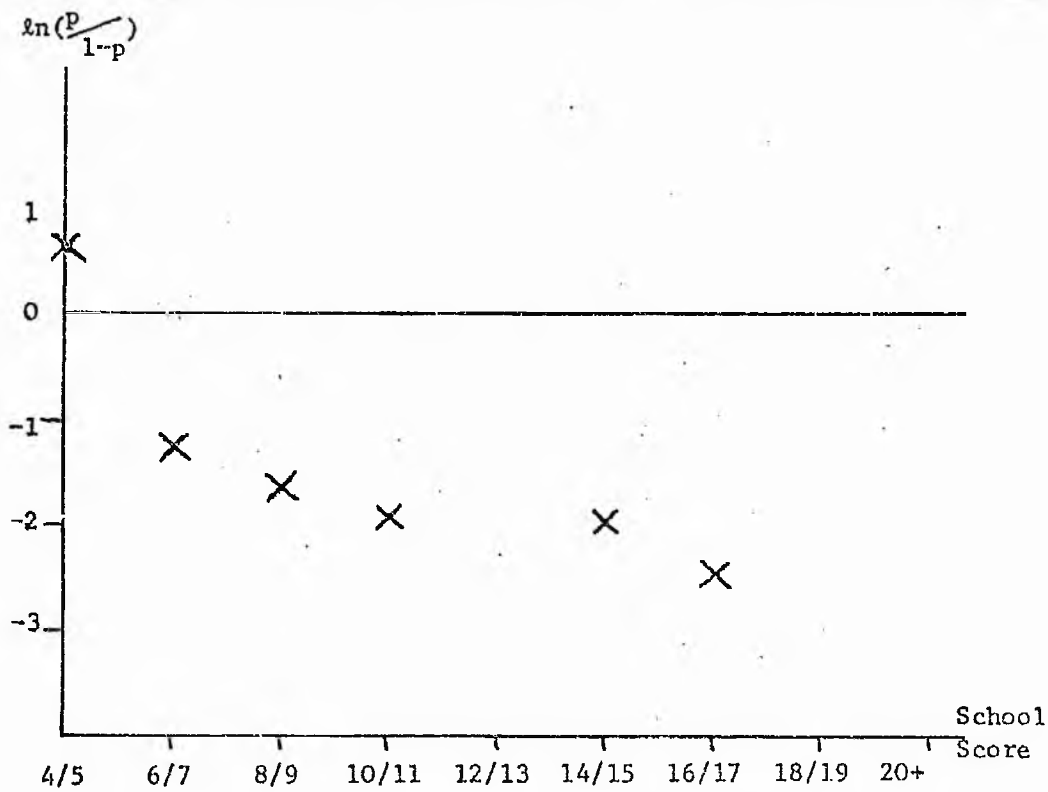
GRAPH 5:7 1973 ENTRANTS : MALE SCIENCE (FAIL YEAR 1)



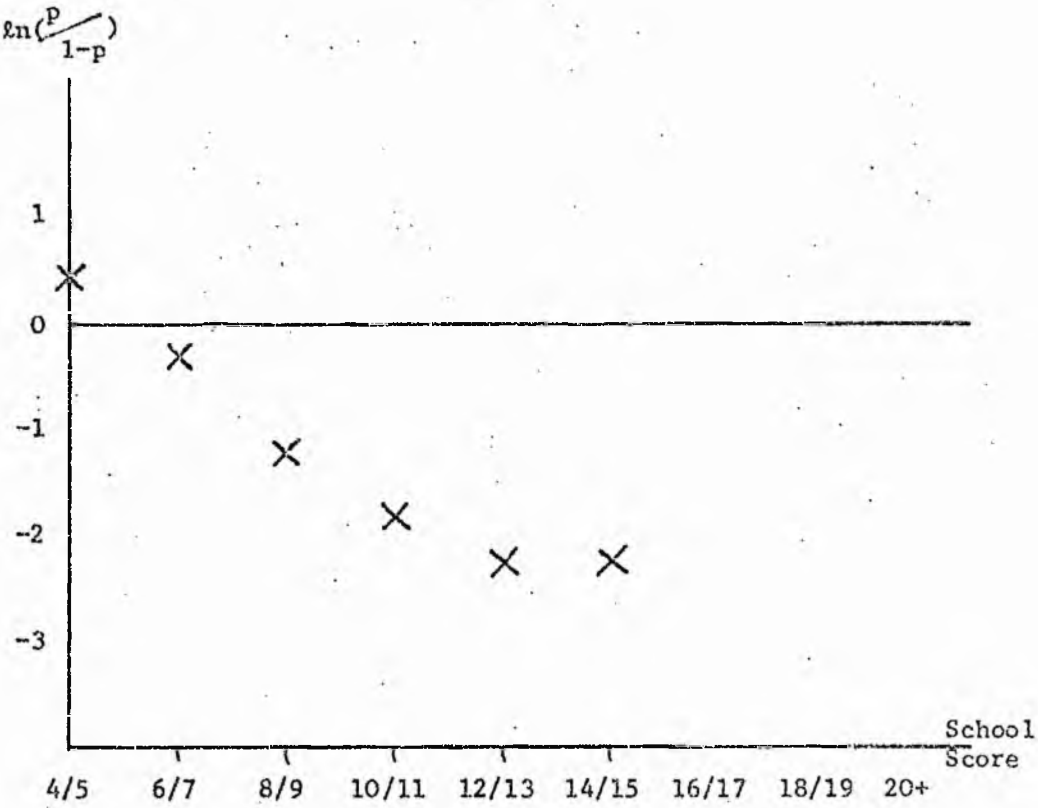
GRAPH 5:8 1973 ENTRANTS : MALE SCIENCE (FAIL AT SOME STAGE OF UNIVERSITY CAREER)



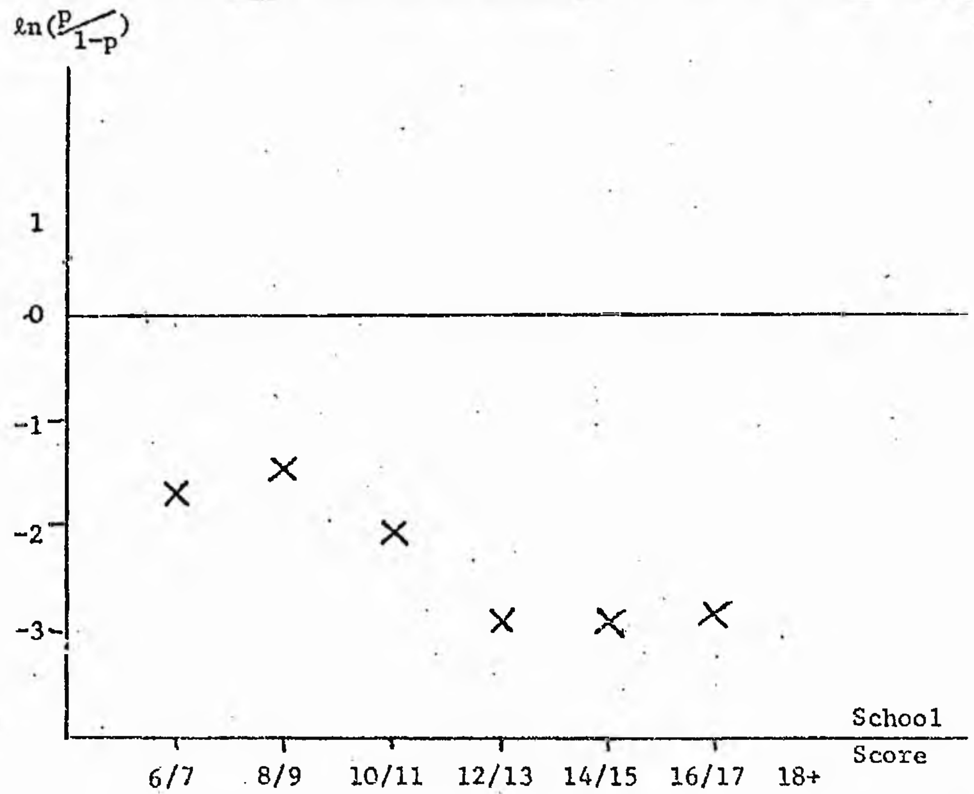
GRAPH 5:9 1971/1972 ENTRANTS : SCIENCE FEMALE (FAIL YEAR 1)



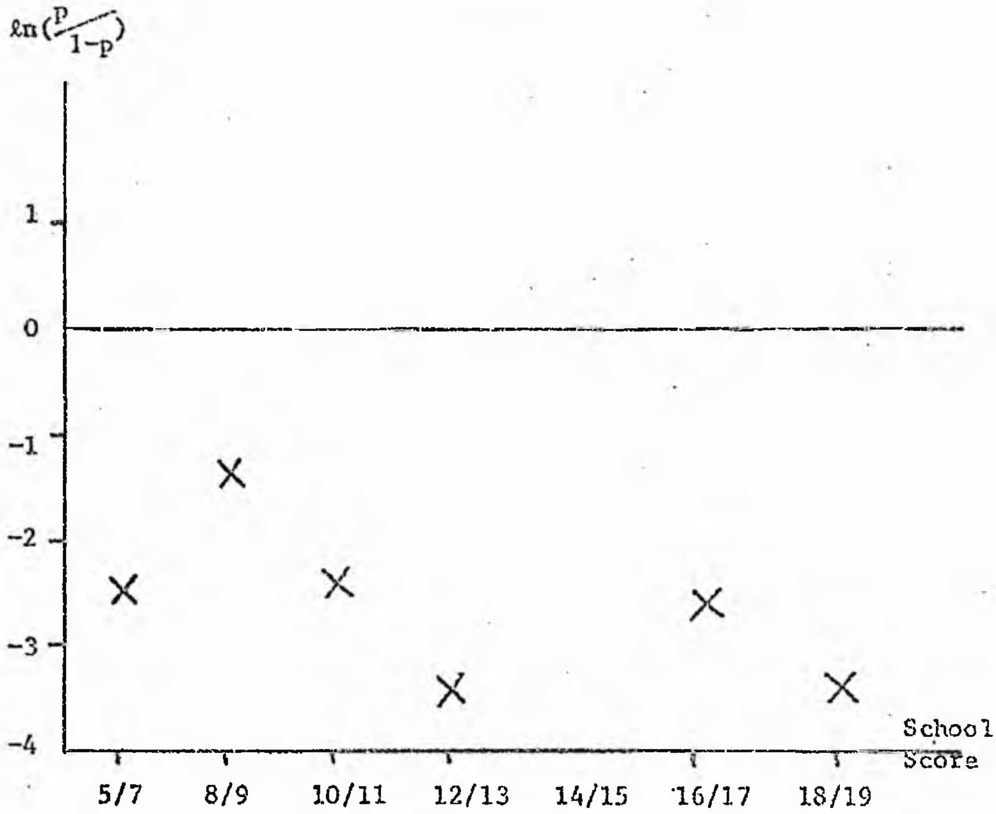
GRAPH 5:10 1971/1972 ENTRANTS (FAIL AT SOME STAGE OF UNIVERSITY CAREER (SCIENCE FEMALE)



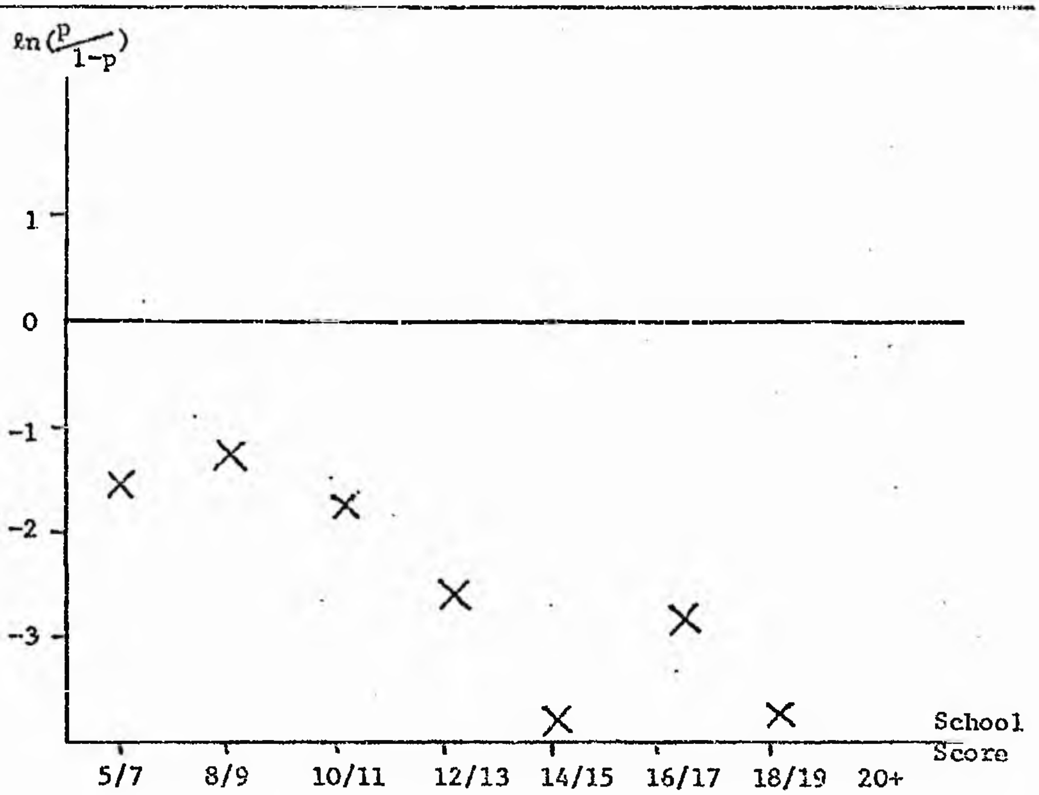
GRAPH 5:11 1973 ENTRANTS : SCIENCE FEMALES (FAIL YEAR 1)



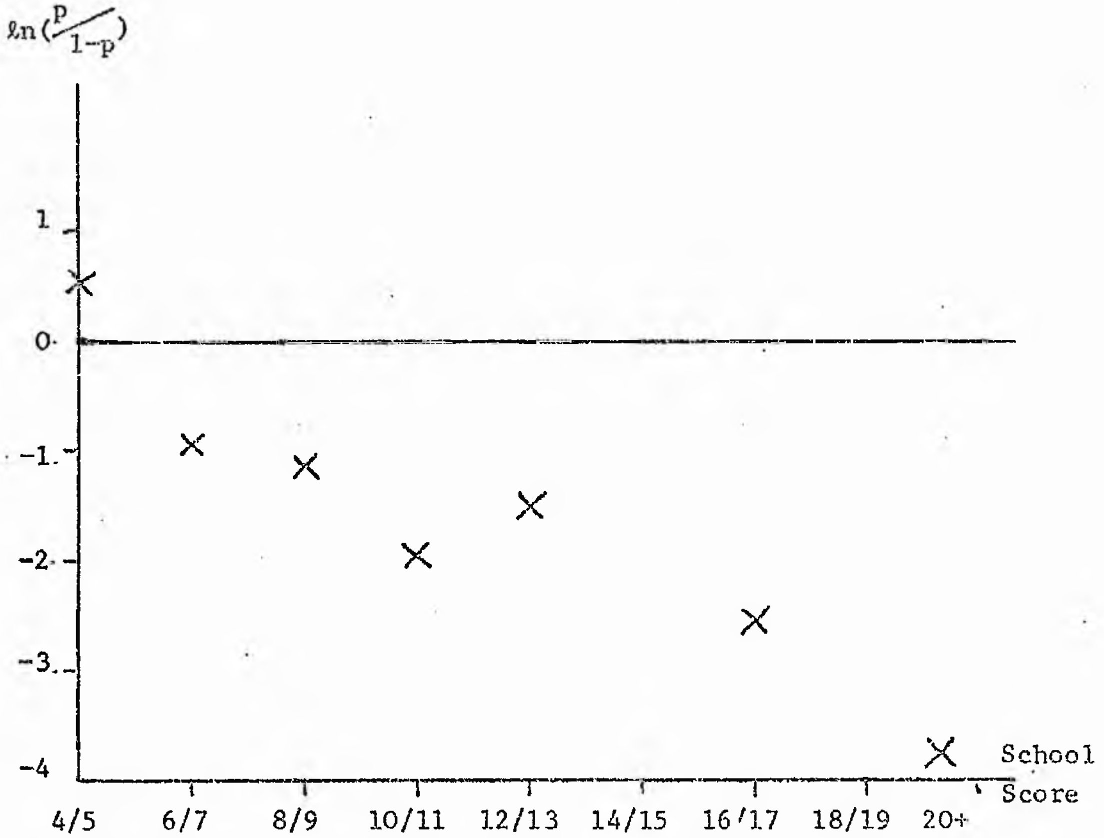
GRAPH 5:12 1973 ENTRANTS : ARTS FEMALES (FAIL YEAR 1)



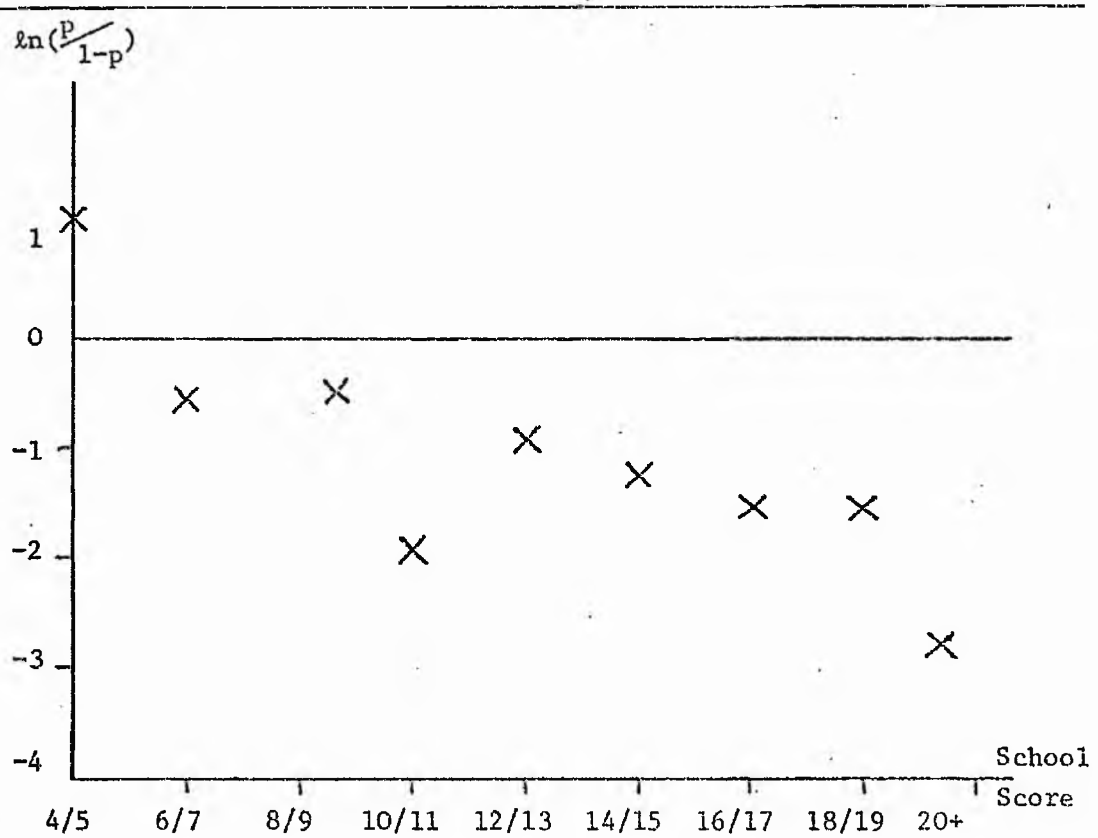
GRAPH 5:13 1971/1972 ENTRANTS : ARTS FEMALES (FAIL YEAR 1)



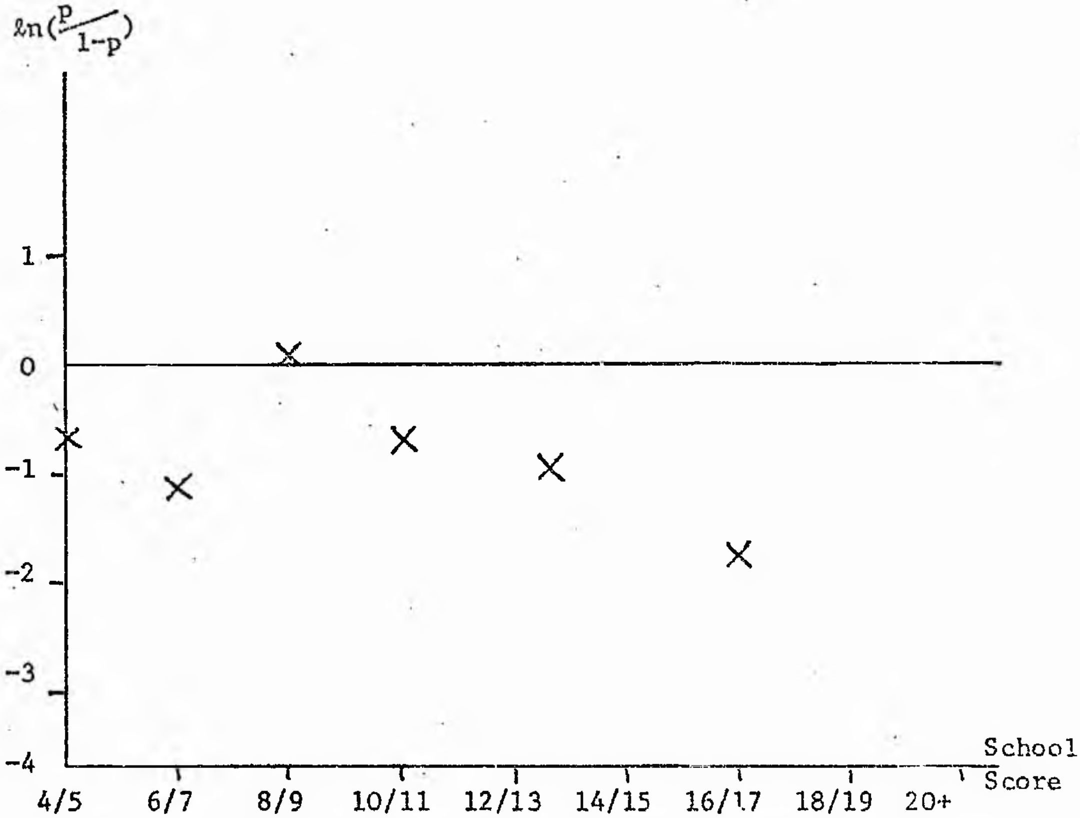
GRAPH 5:14 1971/1972 ENTRANTS : ARTS FEMALES(FAIL AT SOME STAGE OF UNIVERSITY)



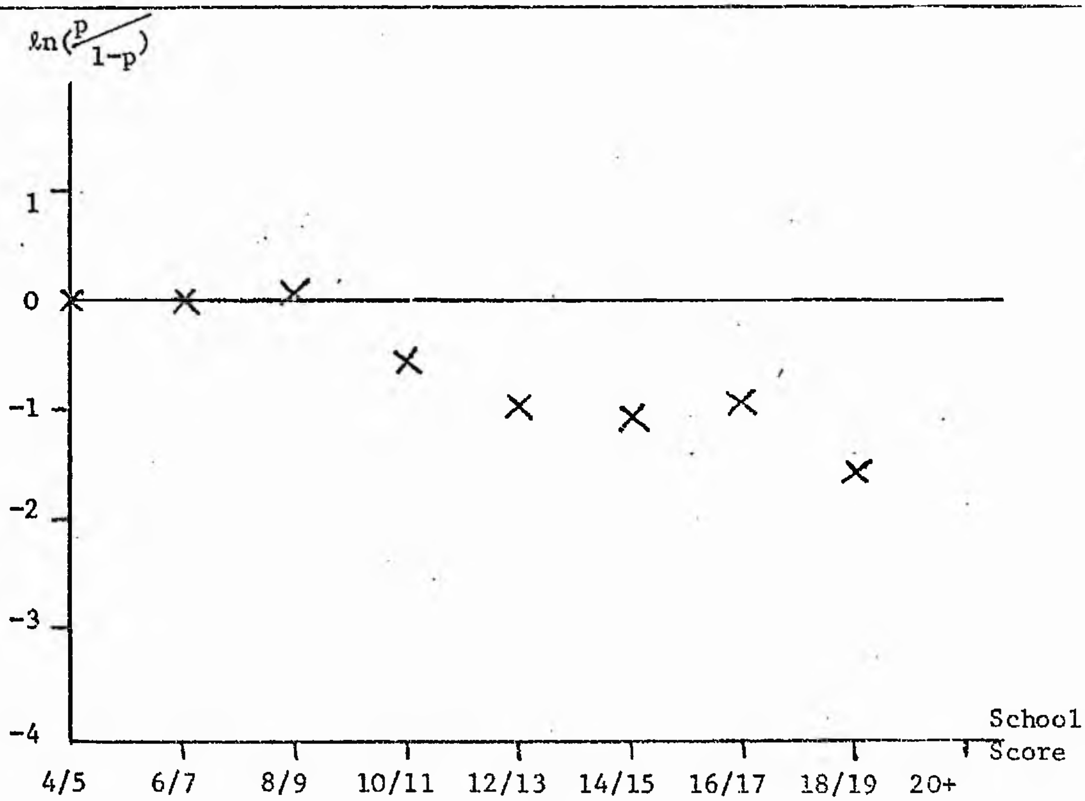
GRAPH 5:15 1971/72 SCE ENTRANTS : MALE SCIENCE (FAIL YEAR 1)



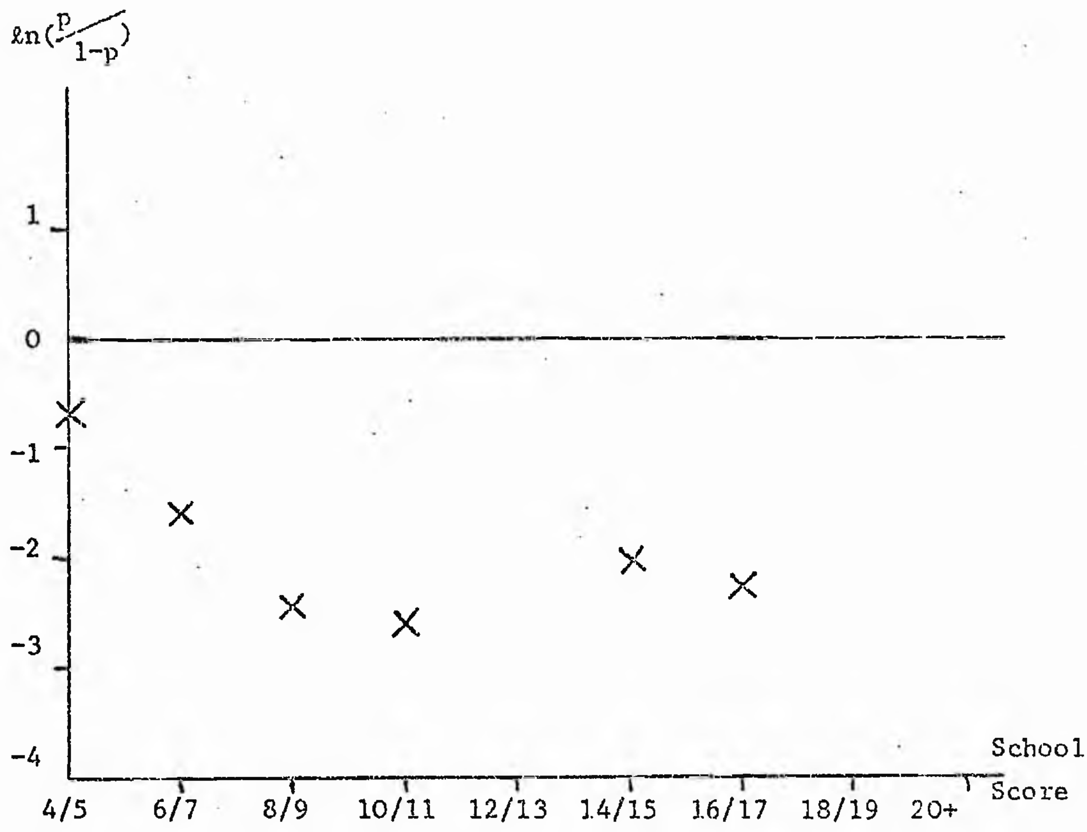
GRAPH 5:16 1971/72 SCIENCE MALE ENTRANTS (SCE) (FAIL AT SOME TIME)



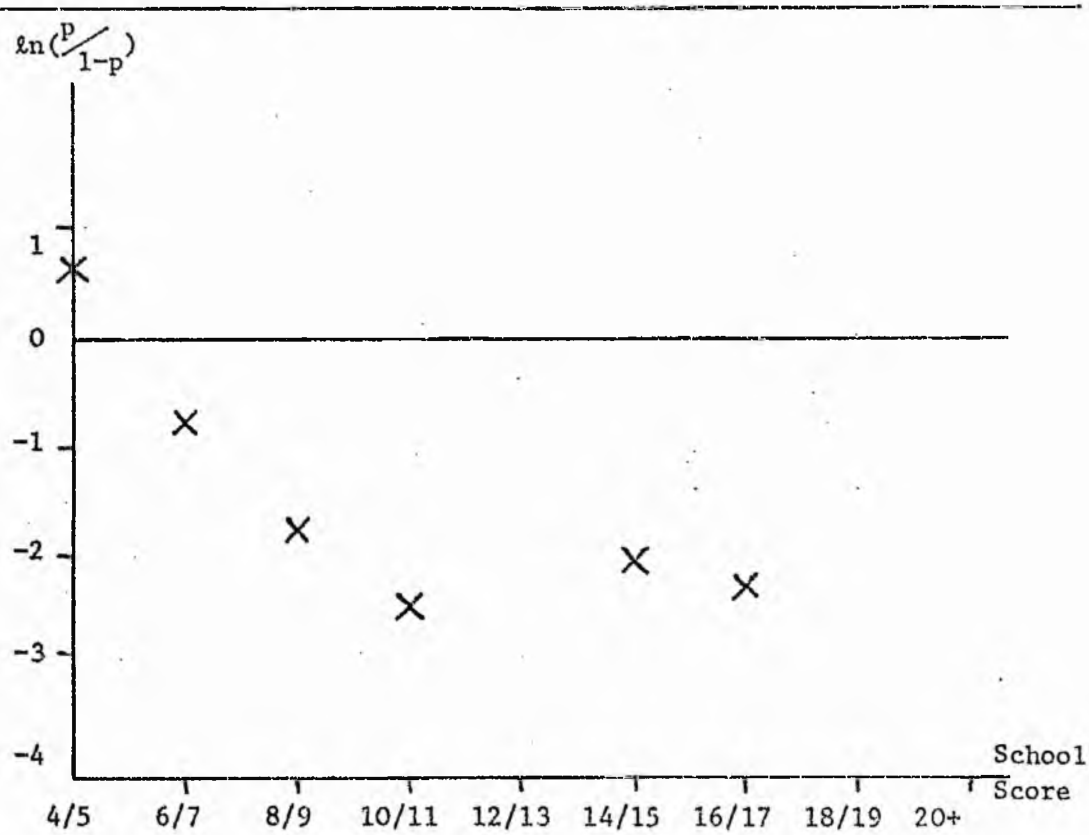
GRAPH 5:17 1973 SCE ENTRANTS : MALE SCIENCE (FAIL YEAR 1)



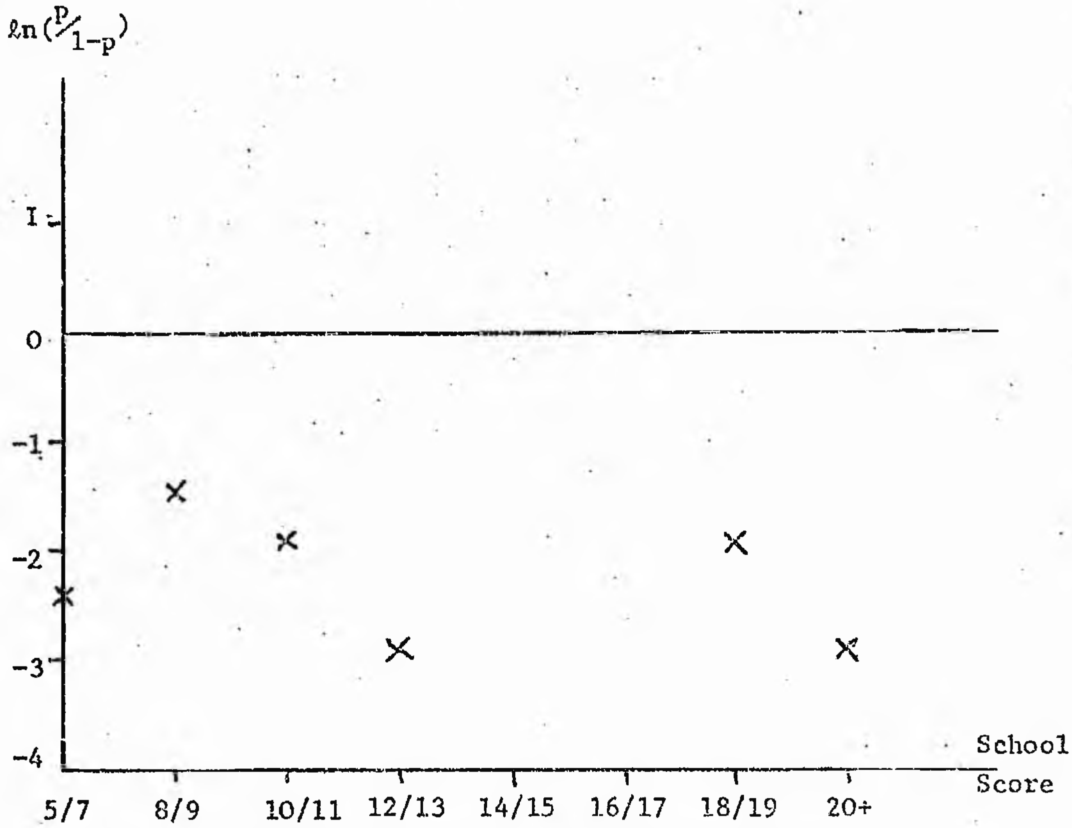
GRAPH 5:18 1973 SCE ENTRANTS : MALE SCIENCE (FAIL ANY TIME)



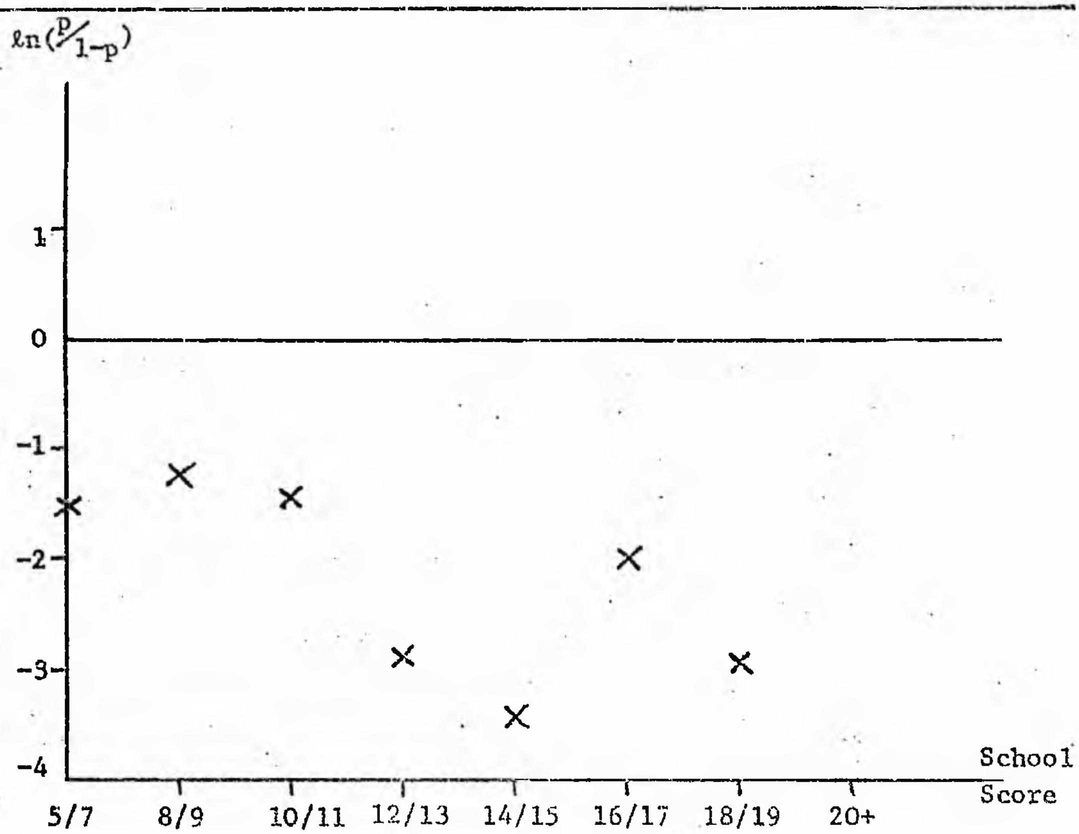
GRAPH 5:19 1971/72 SCE SCIENCE FEMALES (FAIL YEAR 1)



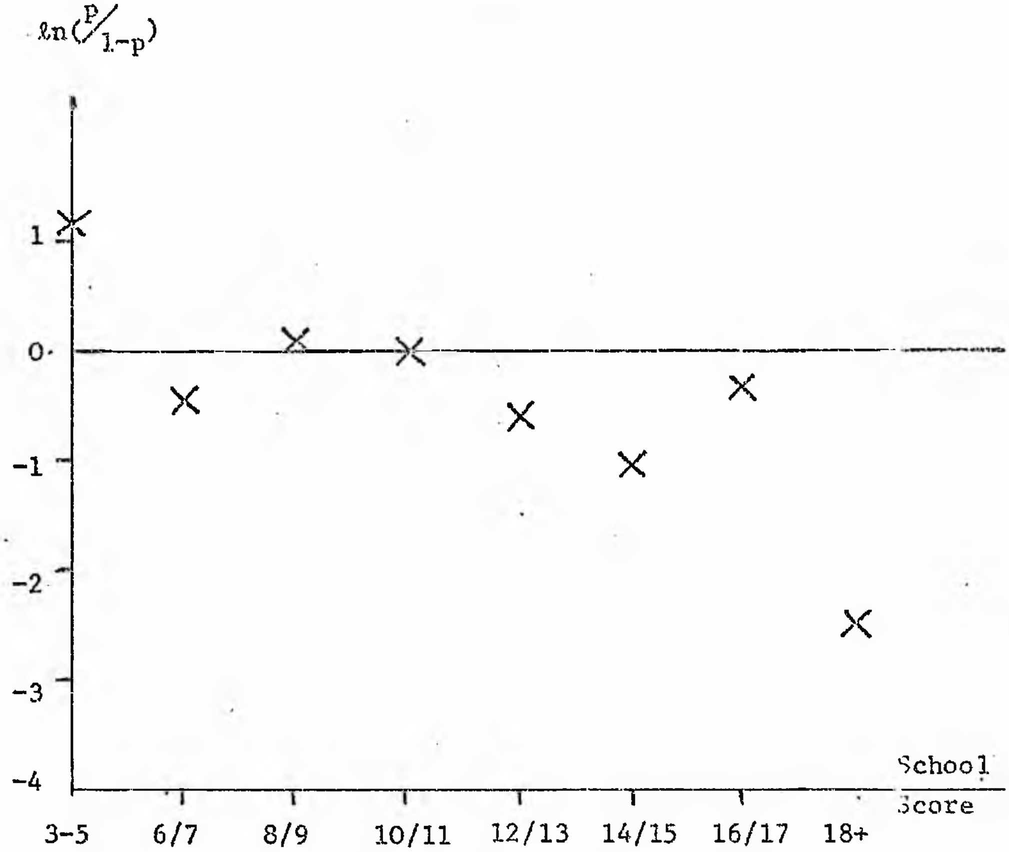
GRAPH 5:20 1971/72 SCE SCIENCE FEMALES (FAIL AT ANY TIME)



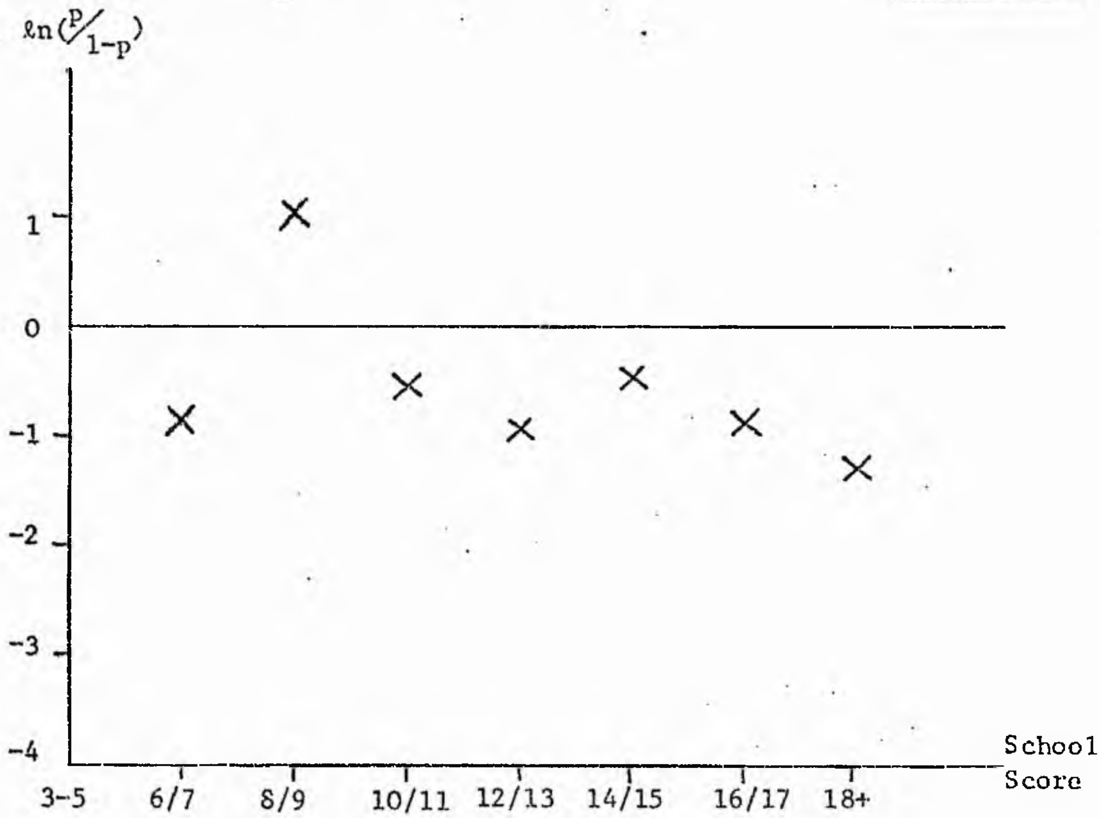
GRAPH 5:21 1971/2 SCE ENTRANTS : ARTS FEMALES (FAIL YEAR 1)



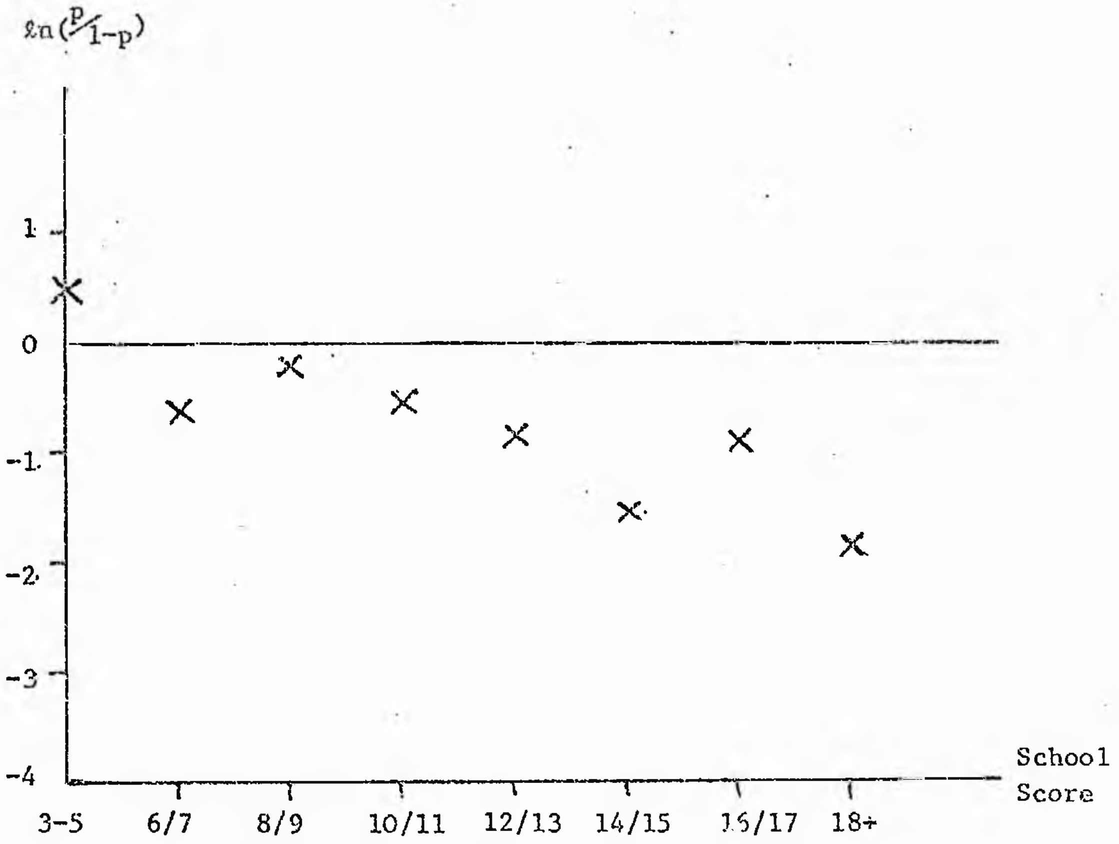
GRAPH 5:22 1971/2 SCE ENTRANTS : ARTS FEMALES (FAIL AT SOME TIME)



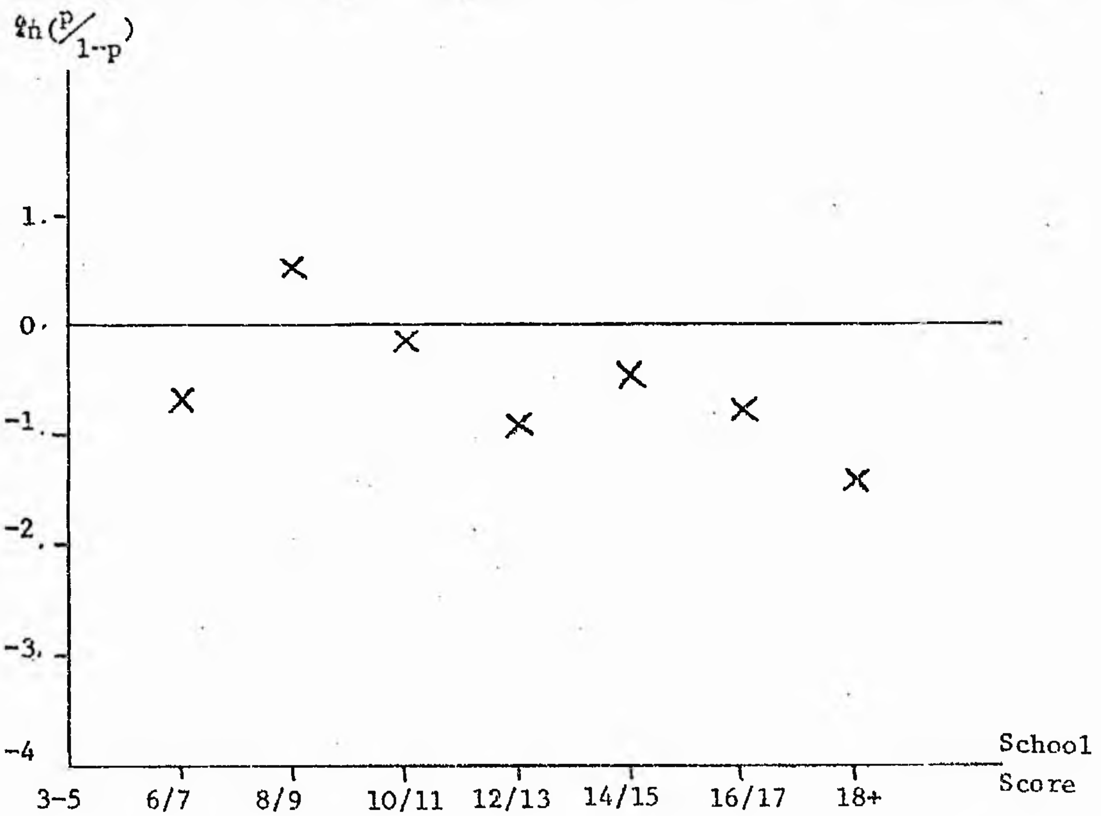
GRAPH 5:23 GCE ARTS ENTRANTS : THIRD/ORDINARY/FAIL : p



GRAPH 5:24 GCE SCIENCE ENTRANTS : THIRD/ORDINARY/FAIL:p



GRAPH 5:25 ALL GCE ENTRANTS : p = proportion with THIRD/ORDINARY/FAIL (MALE)



GRAPH 5:26 ALL GCE ENTRANTS (FEMALE) : THIRD/ORD/FAIL = p

CHAPTER 6

ACADEMIC AND SOCIAL EXPERIENCES OF FIRST YEAR

6.1 Introduction

In Chapters 4 and 5 we have considered some of the statistical problems of explaining the differential performance of SCF and GCE qualified students, and have considered methods of predicting this performance. As we have observed, most of the differences between SCE and GCE performance are more pronounced during the first year at university. In this chapter we will consider first year performance in detail, and will attempt to identify some of the qualitative reasons for this differential.

The main focus for the analyses of this chapter is a survey of the academic and social experiences of a sample of those students who entered St Andrews in October 1976. The survey was conducted for the Student Academic Performance Committee at St Andrews and formed part of a national survey of tertiary education in Scotland, with similar surveys being undertaken at Edinburgh, Glasgow and Strathclyde Universities, at Paisley College of Technology and at all the Colleges of Education. The questionnaires were distributed under the auspices of the Centre for Educational Sociology at the University of Edinburgh but all other work took place at St Andrews.

The cornerstone of the survey was a thirteen page questionnaire which was constructed by a committee from each of the participating institutions. It contains sections on the students' academic background, their experience of their courses both at school and at university, their social experiences and their personal characteristics. The full questionnaire is in Appendix B.

The questionnaire was distributed in August 1977, during the summer vacation following the students' first year. The sample at St Andrews comprised every student who had attended a school outside Scotland and those Scottish students who had not received a questionnaire during a different national survey one year previously. The sample thus comprised 614 students, of whom 528 replied - a response rate of 86 per cent.

The students were offered the choice of replying anonymously or not. For those who permitted themselves to be identified it was possible to merge data on their first year academic performance and for 65 per cent of the sample this was possible. Collection of the data on performance required a large amount of work. In the Faculty of Science, data are held centrally, but in the Faculty of Arts, the only data which are kept centrally are the records pass/fail in each subject. Therefore it was necessary to contact each department and extract more comprehensive data from departmental records. Further problems were caused by the different methods of assessment used in different courses. In some cases, it was possible to obtain a quantitative measure of performance only over the year as a whole, and not possible to obtain a relevant measure of their performance at Christmas or Easter.

Let us now consider how representative our sample is of the cohort who entered St Andrews in October 1976. We will approach this in three ways. Firstly, we will compare the school performance of entrants to the Faculties of Science and Arts for the sample and for the population as a whole. The comparative figures are displayed in Table 6:1[1] and show that the distribution of school qualifications among the sample is very similar to that for the population as a whole. This is especially so for GCE qualified entrants.

Secondly, we consider the performance of those members of the

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[1] With the exception of Table 6:15, 6.31, 6.45, all the tables referred to in this chapter are situated at the end of the chapter. Table 6.15, 6.31 and 6.45 appear in the text.

sample who permitted themselves to be identified. Table 6:2 gives statistics on the performance of these students for those subjects which had a fairly large number of students taking them, while Table 6:3 gives the comparative figures for the whole population. Clearly, there is little difference in the mean performance of the two groups. As one might expect, there is a tendency for the mean performance of the sample to be greater than that for the population as a whole, indicating that the non-respondents included a group of poor performers, but for no subject was this difference significant. An indication of whether the sample truncated the distribution of the population at either end may be obtained by comparing the respective ranges. Again, there is little difference.

Thirdly, we consider the distribution of the grades awarded to the students for their performance over the whole year. Table 6:4 displays the results for respondents (R) and non-respondents (NR). The group of non-respondents includes not only those who failed to return a questionnaire, but also those SCE students to whom a questionnaire was not sent.

There is no evidence to suggest that the non-respondents differ from the respondents in ten of the subjects under consideration, while in one, Economics, those who performed well were under-represented. In five subjects, the four Mathematics options and French, there was a tendency for those who performed poorly to be under-represented. These results are encouraging and mean that in most subjects we may infer with confidence from our sample to the cohort of entrants. It will be necessary, though, to take care when considering results among Mathematics students. Table 6.5 shows that it is in the Mathematics subjects that the non-respondents are more likely to have to resit their courses than the respondents.

With regard to personal characteristics, there is no evidence to suggest that the respondents differ from the non-respondents with regard to sex or age. The only factor on which the sample is unrepresentative is that of the academic background of the students, the structure of the sample meaning that GCE students are overrepresented. However, as most of the analyses to be presented here compare the group of students with SCE qualifications with those with GCE qualifications, this will not affect the relevance of our results.

In summary, previous evidence (eg Entwistle and Wilson (1977)) suggests that those students who perform poorly may be less likely to respond than those who perform well. With the exception of Mathematics, however, this sample does not conform to these expectations. In general, we may conclude that intra-subject comparisons of the performance and experiences of SCE and GCE qualified students will be representative of the cohort as a whole.

This chapter will comprise a further seven sections. The first will consider the performance of the students with respect to their academic background. The following sections will consider the experiences of the students of teaching and learning at school and university and of their opinions of and their difficulty with their first year courses.

6.2 THE PERFORMANCE OF SCE AND GCE QUALIFIED STUDENTS IN THEIR FIRST YEAR AT ST ANDREWS

The differences between the performance of SCE and GCE qualified students is the fundamental problem of this thesis. We have thus far been able to consider the relative performance of the two groups of students only in terms of the grades the students attained over the year. In this section we are able to consider more powerful data in the form of the actual marks gained by the students which will enable us to look more closely at the relation between the respective school qualifications and subsequent academic performance.

Most of the analysis here will centre on the mark on which the student's performance in each course for the year was assessed. Those Arts subjects for which a measure of performance for the Christmas and Easter terms was not available are excluded from the analyses for these terms.

Statistics on the performance for each subject over the whole academic year were displayed in Table 6:2. It may be seen that there is little difference in the mean performance in different subjects. However, analysis of the standard deviations and the ranges reveals a distinct faculty difference. Firstly, using variance-ratio tests we reject the hypotheses of equality of variance for each Arts and Language subject in comparison with any Pure Science subject. Secondly, ranking the ranges reveals the following groupings: Pure Science and Mathematics subjects occupy ten of the top eleven ranks, Social Science subjects two of the next three and Arts and Language subjects the bottom six. This indicates that in the Science faculty, where assessment is likely to be more rigorous and objective, more students perform very well, but also, more very poorly, which may partially explain the disproportionate failure rate between Arts and Science. These results agree with those reported elsewhere, eg McPherson (1975) and Wilson (1969).

6.2.1 SCE and GCE Differences

Let us now consider Tables 6:6 and 6:7. These display the mean performance of SCE qualified and GCE qualified students over the first two terms. There are a number of points of interest. Firstly, over the first two terms 37 comparisons are possible. In 16 of them the mean performance of GCE students was greater than that of SCE students, while in a further 15 the difference was less than one mark. However, in only six of these were the differences significant: one Arts subject, two Social Science and three Science. This demonstrates that SCE students are performing worse than GCE students in both Science and non-Science subjects, but that in non-Science subjects they are able to complete the year successfully.

Let us consider the standard deviations of the marks in the Christmas and Easter examinations. In both examinations the standard deviations of performance for SCE students is greater than that of GCE students in 14 out of 18 Science subjects, but these differences are significant only for Applied Mathematics and Zoology at Christmas. There is no such consistent tendency in the Arts subjects. These results confirm that some SCE Science students perform very well and others very poorly.

Table 6:8 displays the results in June for SCE and GCE students. SCE students were, in general, less likely than GCE students to be awarded a merit or a rank (except in Mathematics). Among those students who were required to resit an examination there are considerable subject differences but no consistent differences between SCE and GCE students, although in each subject which required a large number of students to resit, there was a greater proportion of SCE than GCE students.

How does performance change over the course of the year? It could be hypothesized that the differences in the performance of SCE and GCE qualified students will narrow over the year, as SCE students become accustomed to living and learning in a university atmosphere.

On the other hand, the differences may grow as GCE students will find the initial work extremely easy and thus may not apply themselves at the start of the year, while SCE students will be extended by their courses and, hence, work harder for the terminal examinations. Tables 6:9 and 6:10 suggest that the latter hypothesis may be more correct. At Christmas, SCE students perform better than GCE students in five of the 17 courses under study while in a further three the differences are extremely small. If we consider the fifteen subjects for which there is no difference in the standard deviation of SCE and GCE students then, by using a randomisation test, we accept the null hypothesis that there is no tendency for either group to perform better than the other. At Easter, however, in only three subjects - two Mathematics and Modern History - did SCE students perform better than their GCE counterparts. The Easter marks are generally lower than those at Christmas - this is true for both SCE and GCE students and is not readily interpretable.

There are some interesting subject comparisons. SCE students perform best in Mathematics subjects and in the Arts faculty. This is not surprising as SCE students in these subjects are the best qualified SCE students. GCE students, on the other hand, perform well in Pure Science and the Arts.

Nisbet and Welsh (1976) report that the best predictor of June performance at Aberdeen University is performance in the Christmas examination. Table 6:9 gives the correlations between Christmas, Easter and June examinations for this sample. Not all the June correlations are calculated as those exempted will not sit an examination. Most of the correlations are high for educational research and indicate that those students who perform well at Christmas also do so throughout the year. Nisbet and Welsh use these results as a justification for an "early warning" system where those who perform poorly at Christmas will be offered extra help in the second term. A problem with such an approach is that it is likely that it will already be too late for many students who will already feel themselves to be not academically suited to university and will be unreceptive to attempts to assist them, or who will be too far behind in their courses to be able to succeed. An optimal "early warning" system needs to take effect at the start of the student's university career if it is to be truly effective.

6.2.2 Differences Between Well and Poorly Qualified Students

Let us then consider how effective the threshold suggested in Chapter 5 discriminates between performance. Table 6.10 gives the mean performance over the year for those students who are well qualified and those poorly qualified[1]. Three points are important here. Firstly, as one might expect, those students who are well qualified perform better on average than those with poorer school qualifications. There are only three cases where this is not the case. Two of these results are for GCE students in Social Science subjects. The only case where poorly qualified SCE students perform well is Physics 'B'. This is because this is a course for non-specialist Physicists, and those taking the course are a mixture of those with poor Highers in Physics and those with very little Physics at all. Therefore those students who are "poorly qualified" have some Physics background, while those who are "well qualified" have not.

Secondly, for every subject, the poorly qualified GCE students perform better than their SCE counterparts. This demonstrates

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[1] Well qualified students are defined as those with an entrance score above eleven, low qualified students as those with eleven or below.

that the academic backgrounds of even poorly qualified GCE students enable them to perform satisfactorily as a group, while similarly qualified SCE students do not have the academic background to be so successful. On the other hand, the well qualified SCE students match their GCE counterparts in eight of the 15 subjects under study, while in the other subjects the mean performance of the SCE students is satisfactory.

Thirdly, we are able to observe clearly the bimodality of SCE performance in Mathematics subjects. For each of the four subjects well qualified students have an average performance over 68 per cent, while the low qualified students averaged less than 50 per cent in Statistics and Applied Mathematics.

6.2.3 Performance and School Qualifications

To what extent are the type and standard of the students' school qualifications an indication of their university performance? Firstly, is the type of course followed by SCE students in their final year at school a good discriminator of performance at university? The number of entrants to St Andrews who gained only CSYS or only Highers qualifications in their last year at school is small, but Table 6:11 enables us to examine whether the differences between SCE and GCE students disappear when we consider only those SCE students with a pedagogy of CSYS and Highers courses in their final year at school. For each of the Pure Science and Mathematics subjects, the average performance of those students with CSYS subjects is above that for the sample of SCE students as a whole, which confirms that those students most 'at risk' of poor performance in Pure Science and Mathematics are those who have taken only Highers subjects. This is supported by

Table 6:12 which gives the mean performance for seven of the larger courses for those SCE students with a particular CSYS and those with only the relevant Higher. In each case those with a CSYS performed better, the differences being significant in each of the Science subjects.

Table 6:13 displays the correlations between school qualifications (as expressed by the entrance scale derived in Chapter 4) and performance in first year. These correlations are, on the whole, good for educational research, which is an indication of the success of the scale. They are higher for SCE students in all but three courses, which might be an indication that GCE qualified students appreciate that they may not have to work to the extent of their ability to complete their first year successfully. As a result, much of the variation in first year GCE performance may be due to non-intellectual factors.

The correlations between each course and the corresponding school subject are not markedly different from those for overall school performance and in some subjects they are lower: for example, in Geography the difference between the structure of the subject at school and at university may contribute to this lack of association. Another cause of low correlation between SCE students' performance in a particular subject at school and in the same subject at university is that the entrance requirements for certain courses (eg French) are a very good Higher pass. This leads to a high degree of homogeneity among the SCE students and thus low correlations.

Finally, Table 6:14 permits firstly the comparison of the mean performance of those SCE students who performed well in a subject with their GCE counterparts and secondly a similar comparison for those who performed poorly and were required to resit the subject in

September. For most of the subjects for which comparisons are meaningful, there is no difference between GCE and SCE students who performed well, with the exception of Physics and Botany where GCE students performed better than their SCE counterparts. More importantly, however, for each subject except Mathematics the proportion of SCE students who perform poorly is greater than that of GCE students.

6.2.4 Summary

This analysis of performance in first year has demonstrated differences between SCE and GCE qualified students. A lot of the differences are small and many SCE students acquit themselves very well. Poorly qualified SCE students are the group who appear to be most at risk which illustrates once more the need for the university to make a positive effort to assist these students to complete their first year successfully.

The association, for SCE students, between the type of course they took during their last year at school and university performance is shown clearly as those who had followed a CSYS course performed better than those with only Higher qualifications.

In the following sections we will attempt to identify some of the problems that cause similarly qualified students to perform differently.

6.3 THE TRANSITION FROM SCHOOL TO UNIVERSITY

It has already been demonstrated that there are several important differences between the pattern of secondary education in Scotland and that in the rest of the United Kingdom. Scottish secondary education is, usually, shorter in duration, less specialised in nature, the sixth year may take a number of forms and the proportion of the relevant age group who enter university is higher.

These characteristics of Scottish secondary education have been partially responsible for an Honours degree in a Scottish university taking four years rather than three as is normal elsewhere in the United Kingdom. To some extent, the first year in Scotland is used to consolidate the broad educational base of the Scottish entrants with the specialised knowledge needed to undertake an Honours degree. It is not surprising, then, that GCE students, who are likely to have spent their last two years studying three cognate subjects for 'A' level, report that they do not have to work as hard as their SCE counterparts during their first year at university. Table 6:15 shows that SCE

Table 6:15: How hard did you work in your last years at school?

	Lower Sixth			Upper Sixth			University		
GCE	34	34	33	11	27	62	28	43	29
	Little		Lot	Little		Lot	Little		Lot
SCE	15	22	64	35	37	28	9	29	62
	Fifth Year			Sixth Year			University		

N.B. Due to rounding up or down some percentages do not add to 100

students reported that they worked harder in their fifth year at school and first year at university while GCE students worked harder in their upper sixth.

However, these differences in the content and structure of the two school systems are not the sole reasons for the different failure rates. Another potential cause of the difference in performance between SCE and GCE qualified students is the ease with which different students adjust to the transition from school to university. Those students who experience least difficulty in making this adjustment are likely to settle into profitable study more quickly. This transition from school to university is an extremely complex one. Many factors, both academic and social, influence this change, but in this section we will only consider changes in the methods by which the students learnt at school and at university.

One of the items on the questionnaire[1] asked the students to report how frequently they had encountered various kinds of teaching and learning situations - such as having notes dictated to them or being asked to write essays - during their final year at school and then during their first year at university. They were asked to rate each method of studying on a five point scale, 1 indicating that they had never studied in this way and 5 that they often did so. Tables 6:16 and 6:17 show the frequency with which each method was used at school and university. It may be seen that GCE qualified students were more likely to have experienced the self-directed types of learning, such as making one's own notes and writing essays, at school whereas SCE qualified students who had taken only Highers courses in their final year at school were more likely to have experienced methods such as using duplicated notes and doing exercises. At university these differences were, in general, eliminated.

A more efficient way of using these data to describe the amount of change is to construct transition matrices and calculate indices to measure that change. The indices used come from social

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1 Pages 4 and 10.

mobility table analysis. There are many such indices (Bibby (1975)) and it is important that a suitable index is used. We require an index that satisfies two main criteria. Firstly it should discriminate between an increase in the use of a method of study at university and a decrease. Secondly, in order to facilitate the dissemination of results the chosen index should be readily interpretable. An ideal index would equal one, say, if every student experienced an increase in the use of a method of study, zero if there was no trend either way, and minus one if every student experienced a decrease.

Three indices were considered: (a) Hutchinson's (1958) $f = a - b$ where $a = \frac{1}{n}\sum_{j<i} n_{ij}$ and $b = \frac{1}{n}\sum_{j>i} n_{ij}$; (b) Galtung's (1966) $g = \frac{a-b}{a+b}$ and (c) Bartholomew's (1975) $d = \Sigma n_{ij}|i-j|$. Hutchinson's f is the simplest and satisfies both criteria but suffers one disadvantage in that it equals zero whenever $\sum_{i>j} n_{ij} = \sum_{j>i} n_{ij}$, which could lead to misinterpretation of any resulting coefficient.

Galtung's g is essentially a normalized version of Hutchinson's f. It has one major drawback for our purposes. Consider Figure 6.1. In this situation we might expect the index to equal 0.6 as 60 per cent of the students have experienced an increase, and none a decrease. However, Galtung's $g = \frac{60-0}{60+0} = 1.0$. This effectively excludes it from our consideration.

	1	2
1	20	60
2	0	20

Figure 6.1

Bartholomew's index does not allow for differences between increases and decreases in the amount a study method is used. However, if it were adapted to $d^* = \Sigma n_{ij}(i-j)$ it would. It also allows for differences in the amount of increase or decrease, but it is a difficult index to interpret. This is because the upper and lower bounds are variable for transition matrices of different dimensionality. They are always greater than 1 or less than -1 for matrices with dimensions greater than 1. However this could be overcome by scaling (i-j) to constant range.

For this study it was decided to use Hutchinson's index with care taken to examine the structure of any index close to zero.

Standard errors for the index may be calculated by expressing the index as $J = \sum_i \left[\sum_j f_{ij} n_{ij} \right]$ where $f_{ij} = \begin{cases} 1 & j > i \\ 0 & j = i \\ -1 & j < i \end{cases}$

and $\{n_{ij};\ i=1,\ldots,k;\ j=1,\ldots,k\}$ is the observed number in each cell of the $(k \times k)$ transition matrix. Then, if we assume that the rows are independent, i.e. that one's university study methods do not depend on one's school study methods, we may express the variance of the index as the sum of the variances of a set of independent multinomial probabilities as follows:

$$\mathrm{var}(J) = \frac{1}{N^2} \sum_i \mathrm{var}_i$$

$$\text{where} \quad \mathrm{var}_i = N_i \left\{ \sum_j f_{ij}^2 p_{ij} - \left(\sum_j f_{ij}\, p_{ij} \right)^2 \right\}$$

where p_{ij} is the probability of an observation falling in cell (i,j) $\{N_i;\ i=1,\ldots,k\}$ is the row sum, and N the total sum.

We may estimate these variances by

$$\hat{\mathrm{var}}_i = S_i^2 = \sum_j f_{ij}^2\, n_{ij} - \frac{1}{N_i} \left[\sum_j f_{ij}\, n_{ij} \right]^2$$

and hence $\hat{\mathrm{var}}(J) = \frac{1}{N^2} \sum_i S_i^2$

$$\hat{s.e.}(J) = \sqrt{\hat{\mathrm{var}}(J)}$$

For values of J around zero, these standard errors generally take values similar to J. As the magnitude of J increases the magnitude of the ratio of J : $\hat{se}$ (J) also tends, in general, to increase, tending to take values around 3 when J is around 0.2.

Let us now consider the values of the indices. The values for SCE and GCE qualified students are given in Table 6:18. There is a transition effect with all types of students reporting a substantial shift between school and university, but there is also a distinct national difference. SCE qualified students experience a much more abrupt change than their GCE qualified counterparts.

Consider Arts students first. In the first three rows of Table 6:18, five of the six indices are negative whereas those in the remaining rows are positive. Those methods which decrease in frequency at university are those which are "teacher-directed" while the methods that become increasingly common are those that are "self-directed". The latter consist of a set of study methods that are characteristic of university work in Arts subjects: private reading and making one's own notes are used as the basis for essays and discussion in tutorials. Coefficients for SCE students are greater than for GCE students in all but one case, the most striking examples being the increases students experience in making their own notes and preparing essays.

The pattern for Science students is very similar in that "teacher-directed" activities tend to decrease in frequency whereas self-directed activities, with the exception of essay writing, increase. The negative coefficients for essay writing reflect the fact that essays are rarely used in first year Science courses at university. For each of the other self-directed activities the increase is more marked for SCE students. Moreover, they experience a large increase in laboratory work.

There is little difference between the coefficients for GCE students in Arts and in Science. For SCE students, on the other hand, the differences are rather more marked for Arts students than for Science students. Two possible explanations can be suggested. The first can be deduced from Table 6:18 in which we observe that Arts students experienced more self-directed learning at school. They may therefore be more aware of the worth of this type of studying for success in university-type courses, and more prepared to adjust, while Science students feel that if they continue the teacher-directed method that was successful at school they will continue to succeed and, in some cases, experience difficulties as a result. Alternatively, the difference may indicate that teacher direction continues to be prevalent in first year university Science courses.

The students were also asked to state which of the methods of studying they had found the most enjoyable[1], which the best for pursuing their own interests, and which the most useful for examinations. SCE and GCE students agreed on the first two criteria. A majority of both groups chose discussion as the most enjoyable activity and reading as the best way of pursuing one's interests. However, they disagreed on the question of preparation for examinations. SCE Arts students chose reading and exercises as the most useful preparations for school examinations and making one's own notes as the best preparation for university examinations. On the other hand, GCE students chose essay writing and making one's own notes as the most useful activities both

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1 There is a potential source of error in this question in that the students were allowed only to check one item whereas in fact they may have found more than one item equally useful.

at school and at university. Among Science students, exercises were the most frequent choice for both groups but, while for GCE students the next most common choice was making one's own notes (both for school and university examinations), for SCE students the choice was dictated notes.

In summary, SCE students have to make more adjustments to their methods of studying on entry to university than do GCE students, who are more used to directing their own work, and perhaps more conscious of the importance of doing so if one is to succeed at university. Let us now consider whether there are differences between SCE students who pursued different types of courses in their last year at school. These four groups are displayed in Table 6:20. As we have seen, an overwhelming proportion of the students had taken CSYS courses in conjunction with a Highers course.

Table 6:20 gives the mean experience of each method of studying for each of the four groups at school. Given that the aim of the CSYS, as stipulated by the SCEEB Manual, is "to assist the schools in promoting study in depth and the capacity for the independent study of the subject", we should expect that those students who had taken CSYS alone would have experienced more self-directed learning and in both faculties they have done so. However, there is little difference between those who had combined CSYS and Highers and those who had taken only Highers subjects.

Table 6:19 displays the indices of change for those students who had pursued only Highers courses prior to university and those who had attempted a CSYS course. The overall pattern of a shift from teacher directed to self-directed courses is maintained for all groups. Comparisons need to be made with care due to the varying amount of CSYS work undertaken by students. However, for the self-directed types of work the CSYS groups report they need to make similar adjustments to those with only Highers. There are two possible interpretations of this result: firstly, CSYS students are more aware of the types of studying required and therefore more receptive to change. Secondly, CSYS courses are not providing the pedagogy they aim to.

In summary, there are few differences in the adjustments required of the different SCE groups. What is evident from this section is that the Highers examination is not providing those who take it with effective experience of directing their own work, but rather with a technique for passing a particular examination. The CSYS does not wholly rectify this for those students who undertake it. GCE qualified students, on the other hand, not only have a greater knowledge of most of the subjects they will study at university, but also a greater awareness of the optimal methods of learning for a successful university career.

6.4 EXPERIENCES OF FIRST YEAR COURSES

In order to examine which aspects of their first year courses presented the most problems, the students were asked to rate the difficulty of eight dimensions of their courses such as the amount of work required or the concepts and theory involved. The full list of the dimensions asked appears in Table 6:21 which shows the results for Chemistry. The results in this section will be presented for six cognate groups of subjects: Physical and Chemical Sciences; Biological Sciences; Mathematics; Social Science; Arts; Languages.

6.4.1 Physical and Chemical Sciences

One difference is common to most of the subjects under study: GCE qualified students tend to find their courses easy whereas SCE qualified students find them hard. This difference may be seen in Tables 6:21 and 6:22 for Chemistry and Physics students respectively. The pervasiveness of this difference for SCE and GCE students is illustrated by the fact that for no other potential discriminator (eg sex, socio-economic status) were such differences observed.

Let us consider Chemistry first. On the whole, SCE and GCE students of Chemistry in the sample have performed less well at school than other students in the Faculty of Science. GCE qualified students had mean 'A' level grades of ADE or BCE while those for SCE students were AABC which indicates that the SCE students were slightly better qualified. However, around 50 per cent of the GCE students found each of the dimensions easy while few reported that they found the course hard. In fact only 13 per cent thought that the course made severe demands on their ability. On the other hand, few SCE students found their courses easy, while a clear majority reported that they found them hard.

How did the students perform? For each dimension those students who reported that they had found the Chemistry course hard performed less well than those who had reported that they found the course easy or "so-so". An alternative method of investigating performance is illustrated in Table 6:23. The mean difficulty of those students who failed the course over the academic year and were required to resit the examination in September was greater than that of those who passed in June. This is so for each dimension and for both GCE and SCE students. It is interesting, though, that on four dimensions -

"techniques", "concepts", ease of recognising the required academic qualities and amount of work - those GCE students who performed poorly perceived, as a group, the course easier than did those SCE students who perform well. Those dimensions that this group of students report as harder are the demands on ability and memory and on working by oneself. This could indicate that this group of GCE students feel they have a sound background but they lack confidence in their own ability. The extent to which differences in ability affect the ease of the course is reflected by comparing the responses for GCE students from the Faculty of Science and GCE students who were taking a course in Medical Science (who were much better qualified on average). The Medical Science students were even more likely than the Science students to report that they found the course easy and virtually none of them reported that they experienced difficulty with the Chemistry course.

Among SCE students, those who had taken a CSYS course in Chemistry experienced less difficulty than those with only a Higher pass on every dimension except the ease of recognising the required academic qualities.

Many of the students taking Physics also take Chemistry and the difficulties experienced by the students are very similar to those for Chemistry. Too few students have a CSYS in Physics for relevant comparisons to be made.

In summary, SCE students find these courses harder than GCE students especially with regard to the amount of work required although a CSYS pass in Chemistry was found to be an advantage by those SCE students who had taken it.

6.4.2 Biological Sciences

We will look in this section at Botany and Zoology. In general, SCE students found their courses harder than GCE students, but there are some subject differences. Let us consider Zoology first. Zoology, as we have seen in Section 6.2, is one subject where GCE students perform poorly. However, around 40 per cent of the GCE students found every dimension except "memory" and "academic qualities" easy (Table 6:24). SCE students, whose performance is similar to GCE students, find every dimension except "academic qualities" harder.

The dimension that over 60 per cent of both SCE and GCE students reported as hard was the demand on memory imposed by Zoology. This is true both for those students who performed poorly and those who performed well, in contrast to Chemistry where problems with the demand on memory was experienced only by those who had performed poorly. A possible interpretation may be derived from the result that those who performed well in Chemistry reported that they found the concepts easy. If one understands the concepts involved in a Chemistry course it may not be so necessary to commit many facts to memory whereas in Zoology it is essential to memorise a number of basic facts which cannot be reached by any other method.

In general, those GCE students who performed well found the course easier than those who performed poorly; by contrast, SCE students displayed no such consistent differences. Again, unsuccessful GCE students reported that they found the course easier than their successful SCE counterparts on each dimension except "techniques" and "concepts".

Fewer students took Botany, a subject in which, over the year as a whole, SCE students performed well. Nevertheless they again reported experiencing more difficulty than did GCE students. For each dimension except "memory"[1] over 53 per cent of the GCE students found the course easy while SCE students report that the course was "so-so" or hard.

In summary, SCE students reported that they found the courses harder than GCE students despite similarities in the performance of the two groups. This tendency was true both for successful and for unsuccessful students.

6.4.3 Mathematics

The four Mathematics subjects are characterised by a bimodal performance by SCE students, one group of whom perform extremely well, and another extremely poorly. This is demonstrated by the replies to the questions on the difficulty of the courses. Mathematics subjects are the only ones in which as many and, in some cases, more SCE students reported that they found various parts of their first year courses as easy as their GCE qualified counterparts (Tables 6:26 and 6:27).

For most of the dimensions relating to the Mathematics subjects, SCE students reported they found them easier than did GCE students but, in general, there is little difference between the two groups. These results are partially explained by the fact that SCE Mathematics students are the best qualified SCE students in the Science faculty, while GCE Mathematics students are only marginally better qualified than the rest of the GCE entrants to the Science faculty.

There is little difference between the difficulties

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1 Table 6:25.

experienced by SCE and GCE students, whether they were successful or unsuccessful. However, for both groups successful students found the courses a lot easier than unsuccessful students. Unsuccessful students reported that the most difficult dimensions were "amount of work" and demands on memory and ability. We have observed that those students with CSYS Mathematics performed better than those with only Higher Mathematics and therefore it is not surprising that on each dimension they reported that they found the course easier.

To summarise, many SCE Mathematics students found few problems with their course, especially if they had taken a CSYS course. Those who experienced problems tended to be less well qualified and they found most difficulty with amount of work and the demands on their memory and ability.

6.4.4 Social Science

Let us now turn our attention to Economics, Geography and Psychology. To many students taking these subjects at university they will be new subjects, while others find them to be very different from the subject they encountered at school. Hence we might expect differences due to academic background to be less pronounced.

These expectations are, generally, proved. For Geography there are no consistent differences between SCE and GCE students, while for Psychology and Economics[1], GCE students did consistently report that they found their courses easier, but these differences are much less pronounced than for Pure Science subjects. A feature of these

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[1] Tables 6:28, 6:29 and 6:30.

subjects is that both SCE and GCE students found parts of the Economics and Psychology courses very easy. For example, 62 per cent of GCE students and 50 per cent of SCE students reported that the "concepts" required by the Psychology course were easy. On the other hand, all the students found the Geography course hard, especially with regard to the amount of work. They seemed to enjoy this workload, however, for in the open ended question[1], many students praised the content and structure of the Geography course.

Geography and Economics also allow one to examine differences between students whose other courses are Arts subjects and those with a Science bias. For SCE students there was no difference in school qualifications, while for GCE students those from the Arts faculty had better 'A' level results. For Geography, Arts students did perform better (Table 6:31), while for Economics there was no difference.

Table 6:31: Faculty differences in performance in Geography by nationality

		Mean	SD	n
Scottish	Arts	60.00	4.16	13
	Science	57.77	5.87	11
English	Arts	62.11	3.41	9
	Science	54.06	13.97	8

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1 On pages 10 and 13 of the questionnaire, students were asked to comment (a) on the subject they had found most difficult and (b) on their first year as a whole

However, Science students consistently judged their courses to be easier than did their contemporaries in the Arts faculty, which may be due to a familiarity with requirements such as writing up laboratory and field work. These results do indicate again that the higher Science failure rate could be due partly to differences in assessment rather than to academic background and ability alone.

In summary, Psychology and Economics are subjects in which both SCE and GCE students perform well, and they both report they experience little difficulty with their courses. Geography presents its students with a hard option, but they overcome these problems and report it to be worthwhile. Science students find Geography and Economics easier than Arts students.

6.4.5 Arts

These subjects (English, Mediaeval and Modern History, Fine Arts and Philosophy)[1] have the lowest failure rates in the long run. Also, their students are better qualified than Science students. As a result, we might expect that students taking Arts subjects would find their first year considerably less taxing than do their contemporaries in the Science faculty, or at least that any difficulties would be encountered equally by SCE and GCE students.

This is not the case. For each subject, GCE students report they find their courses easier than SCE students. A possible explanation for this lies in the greater adjustment required of SCE students in methods of study, while their proven scholastic ability enables them

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1 Tables 6:32 - 6:36.

to negotiate their first year more successfully than their Science counterparts.

In English, over 40 per cent of the SCE students experienced difficulty with each dimension except "memory"and practical problems while GCE students found the course easy. As we observed for Pure Science students, those GCE students who performed poorly reported that they found the course easier than those SCE students who were successful, and those who had taken CSYS English found every dimension easier than those with only a Higher. This was especially so for the amount the students were expected to work on their own.

In the History subjects and Fine Arts, SCE students reported that they found the difficulty of the dimensions to be "so-so" while GCE students reported them to be easy. There are some subject differences: all students found the concepts required by both Histories as easy (although this could be caused by a difficulty in interpreting the question for these subjects); "memory" was found to be difficult by all Fine Arts students, and "recognising the required academic qualities" proved difficult for both History subjects.

Philosophy was found hard by all students, but especially by SCE students with respect to the dimensions of "techniques", "concepts", "demands on ability" and "recognising required academic qualities", but extremely easy with respect to the amount of work required.

To summarise, there is no difference in performance between SCE and GCE students in Arts subjects, but large differences in their difficulty with the courses. These difficulties are similar to those observed in Science subjects, where there is a much higher failure rate. There are also a number of specific subject differences.

6.4.6 Languages

Only two languages have enough students in the sample to make analyses relevant, namely French and German. The subjects have been described as "linear" subjects, by which we mean that, in the same way as in Mathematics, each new concept learnt requires understanding of a previous set of concepts. Therefore the extra specialisation gained by GCE entrants in their 'A' level courses makes one expect national differences.

This expectation is proven: for each dimension on the courses the expected differences may be observed (Tables 6:37 and 6:38). In both subjects SCE students found especial difficulty with "demands on ability", "recognising required academic qualities", and "amount of work". As with the Pure Sciences, the unsuccessful GCE students reported both courses to be easier than did the successful SCE students.

With the exception of the demands made on the students to work on their own, SCE students with a CSYS in French did not find the course easier than those with only a Higher. One reason for this is the high standard of those students of French with Highers qualifications only. Another (Taylor (1979)) is that language skills - which are dependent on continuous practice - are used little in CSYS work.

6.4.7 Discriminating Between Students

In this section we will consider which dimension discriminates best between Scottish and English qualified students. Data such as these do not lend themselves to classical discriminant analysis and therefore a simple qualitative test was devised. The moduli of the differences between the proportions of GCE and SCE students who reported that they found a dimension hard were calculated. The median difference was then calculated for each dimension across all subjects for which there were enough students for comparisons to be relevant. Similar calculations were made for those students who reported that they found a dimension easy.

The results are displayed in Table 6:39. It may be seen that the dimensions which discriminate most are "amount of work", together with "demands on memory" and "demands on ability". The poorest discriminators are difficulties with practical problems, ability to get on with the work by oneself and "recognising the required academic qualities".

These results are not surprising: students who find aspects of a course difficult will, necessarily, have to work harder on a course and are likely to feel that it is the workload of the course that is giving them problems. For reasons of confidence they will be unlikely to be so ready to attribute the source of their difficulty to their understanding of the techniques and concepts involved in the course. At the lower end of the ranking, one would expect that those courses which presented practical problems, or those which required the student to work alone, would do so irrespective of the educational backgrounds of the students.

The differences between subject groupings which exhibit the least difference are Mathematics (where SCE students perform well) and Social Science (where much of the subject is new to both groups). On the other hand, there are marked differences between SCE and GCE students in Arts (including languages) and Pure Science subjects.

6.4.8 Conclusions

The main conclusion from this section is that GCE students find their courses much easier than their SCE counterparts. In those subjects that are similar to those taken at school (with the exception of Mathematics) unsuccessful GCE students find their courses, in general, easier than do successful SCE students.

An explanation for this latter result is perhaps that GCE students' performance is largely due to non-intellectual factors. To illustrate this, 26 per cent of the GCE students and 31 per cent of the SCE students reported they were required to sit at least one resit in September. However, 66 per cent of these GCE students only had one resit as opposed to 45 per cent of the SCE students, and more GCE students (54 per cent) subsequently succeeded, while only 46 per cent of the resits sat by SCE students resulted in passes. This may be because the GCE students have a more thorough knowledge of the subject to fall back on. In further investigation of this hypothesis, let us examine the item[1] on the questionnaire which asked the students how stimulating, academically and socially, they had found their first year at university. We standardise the students' performance to obtain a measure of performance over the year for each student, and consider the percentages of students in each performance quartile who found their year academically and socially stimulating (Table 6:40). Thus only 35 per cent of the GCE students who performed most poorly agreed that they found St Andrews academically stimulating. It is further interesting that those students in the second quartile may have achieved their success by foregoing some of the social pleasures enjoyed by the least and most able alike.

Those SCE students who had taken CSYS tended, overall, to experience less difficulty with their university course in that subject

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1 Page 11 of questionnaire.

especially with respect to the amount they were expected to work on their own. This supports one of the aims of the CSYS and inclines one towards the first of the conclusions of Section 6.3 (page 240), that although CSYS students reported making large adjustments on entering university, this was partly because they were more ready to adjust and therefore experienced less difficulty subsequently. The SCE students who found their courses difficult reported, in general, that they experienced most difficulty with dimensions such as "concepts" and "ability". An interpretation could be that this is caused by poor preparation for the types of teaching and learning they experience at university, which, in turn, makes it difficult for them to understand the courses.

The value of a subject orientated approach has been shown by the differences that have been highlighted above. Many of these were expected but the ease with which most SCE students of Mathematics and Social Science coped with their courses emphasises, in Mathematics, both the quality of the SCE entrants and the similarities between school and university teaching and learning. In the Social Sciences it demonstrates that where the structure of the subject is new for both SCE and GCE students differences in the extent to which the two groups of students experience difficulty with their courses are eroded.

6.5 PREPARATION FOR UNIVERSITY

We have argued thus far that SCE students not only know less about the subjects they will study at university, but that they are also less prepared for methods of learning that they will be expected to use at university. We will now examine the students' replies to two questions , firstly on how familiar they were with the teaching methods they had encountered at university and secondly how much of the content of their courses they had covered prior to entering university.

The former question asked the students whether they were completely familiar with the teaching methods they had encountered at university or whether some, most or all of the teaching methods at university were new. We would expect that in some subjects (eg Mathematics) teaching at university would be similar to that at school. Table 6:41 displays the percentages for 18 subjects, together with χ^2 values based on the frequencies in each of the tables. We observe that 80 per cent of both SCE and GCE students in English, French and Modern History and 60 per cent in Mathematical methods reported they had previously experienced most or all of the teaching methods they encountered at university.

It is important to note that while percentages of this order occur for the GCE students in 14 of the 18 subjects, SCE students are much more likely to experience new teaching methods.

Table 6:42 shows that those students who were unfamiliar with teaching methods do indeed perform less well than their better prepared contemporaries.

To consider the second question, it has often been suggested that a reason for the discrepancy in failure rates is that some departments pitch their courses at a level above the entrance requirement - a Higher in that subject (SAPC(1975), SARA (1979)).

There are 13 courses which specify a Higher as a requirement for entry to that course. Table 6:43 gives the numbers of SCE students who reported that they experienced a gap between their previous knowledge and the starting point of their university course.

The results indicate that SCE students do not, in general, experience a gap. A possible source of error in this question is that some courses may cover the preliminary material extremely quickly, thus making it difficult for SCE students to keep up.

In summary, these two questions demonstrate once more that SCE students are not as prepared as GCE students for the types of learning they experience at university. However, there cannot be a unilateral solution to the problem by either the schools or the university; what is required is a bilateral approach through greater awareness on both sides of the problems encountered by university entrants.

6.6 STUDY HABITS

Inventories of study habits have been used in many studies, but, as discussed in Chapter 2, with limited success as a predictor of academic performance. This questionnaire used a study habits inventory adapted from that used by Jones et al (1973) and McPherson (1975). The inventory comprised 14 statements such as "I am used to organising my own work" and the students were asked to rate the extent to which they agreed with each statement on a nine point scale where 1 indicated strong disagreement and 9 indicated strong agreement.

Table 6:4 4gives the means of these replies for a selection of the items for SCE and GCE students. As with many previous studies, these inventories do not prove to be good discriminators between groups of students. For the SCE/GCE dichotomy there is a marked difference for both Arts and Science students on only two items although these are important. GCE students were more likely to agree that they were used to organising their own work. This replicates the results of Section 6.2

which suggested that SCE students were less oriented towards "self-directed" learning.

Secondly, SCE students were more likely to agree that they got disheartened if the work became difficult. In fact 57.9 per cent of the SCE Arts students and 57.7 per cent of the SCE Science students expressed agreement with the statement. It is essential that students feel able to overcome any difficulties they may encounter in their work, and feel able to obtain any advice when they need to do so. Unfortunately, for many SCE students this is not the case. Only 40 per cent of the SCE Science students reported that they felt they knew their lecturers well enough to receive useful advice on their work, while 65 per cent of the SCE Arts students did so.

Table 6:44 presents the replies to the statements for groups of SCE students with different experiences in their last year at school. There are no marked differences between the groups, but those students who had stayed on for a sixth year and only taken Highers courses in this time are more likely to agree with each of the statements such as "I easily get distracted when I am studying" or "I find it difficult to work for more than an hour at a time", agreement with which might be expected to be associated with poor performance. However, there is no difference between those students who had come straight from fifth year and those who had taken CSYS courses. This indicates that the differences may be caused by differences in ability (sixth year leavers with only Highers are the least well-qualified group of entrants) rather than as a result of the student's educational background.

Correlations between the replies to the inventory and performance yielded only one consistent result: a strong positive correlation between performance and being used to organising one's own work. For no other item for any group of students was there any evidence of a high association. If the replies were dichotomised to expression of agreement or disagreement with a statement there were no significant differences between the performance of the two groups across all subjects, other than that for "organising one's own work".

In summary, the replies to the study habits inventory indicate that items in the inventory do not distinguish well between different levels of performance. There are two possible conclusions: firstly that there is no simple definition of a "good" study habit and that such univariate approaches are doomed to failure; secondly that inventories may be too simple and, as suggested in Chapter 2, the only true method of understanding an individual's study habits is through the use of in-depth interviews.

6.7 PERSONAL CHARACTERISTICS AND ACADEMIC PERFORMANCE

This section will consider whether different personal characteristics of SCE and GCE students may account for some of the differences in performance.

6.7.1 Age

There is likely to be a distinct difference in the age structure of the groups of SCE and GCE students. SCE students who enter university direct from their fifth year will only be 17 (and in some cases 16) years old on entry. GCE students, on the other hand, will generally be 18 if they enter university directly after taking their 'A' levels. This extra year may mean that the GCE students will be more mature, and therefore more able to withstand the pressures of university life.

St Andrews is a special case in Scotland in that a majority of the SCE entrants have stayed on for a sixth year, and many of the GCE students enter one year after first sitting 'A' levels, some having stayed at school in order to attempt entrance to Oxford or Cambridge universities while others have taken a year off for non-academic reasons. The age structure of the two groups is shown in Table 6:45.

Table 6:45: Age structure of entrants in sample

Age on entry	SCE %	GCE %
17 or less	26	6
18	65	54
19 or more	9	40

The differences in performance between different ages were examined for seven large classes: French, Mediaeval History, Geography, Chemistry, Zoology, English and Mathematical Methods. For each subject the SCE 17 year olds performed less well, as a group, than the 18 year olds. However, only two of these differences were significant (Chemistry, Zoology). Table6 :46 displays partial correlations between age and performance controlling for ability and demonstrates that these age differences are caused primarily by differences in ability and academic background rather than maturity. There were no consistent differences between 18- and 19-year-old entrants.

We have discussed some of the benefits that may accrue to students who have taken a sixth year. It seems that it is these benefits rather than age on entry which accounts for differences in performance between SCE students who have undertaken a sixth year and those straight from fifth year.

6.7.2 Performance and Sex

In Chapter 5 we observed that SCE males were more likely to fail their first year than their female counterparts. This observation is supported by the performance of the students in the sample. In the Science Faculty, SCE males were more likely to have to resit their courses than were their female counterparts and were therefore more at risk of having their studies discontinued. The females, on the other hand, were more likely to pass the subject by June. Furthermore there was no evidence of any differences in the proportion of males and females in the Science Faculty who gained a rank certificate or of sex differences in the Arts Faculty.

Table 6:47 gives the mean performance for each of the groups and shows that, for those subjects where comparisons are relevant, there is no evidence, in general, of any difference in the performance of the two sexes.

If we consider the replies to the questions on experience of first year courses, there are again few marked differences. Males report that they found Science courses easy, but this was due more to a tendency by the females to report that they found the courses "so-so", and in many cases there was also a greater proportion of male students who found their courses hard.

6.7.3 Performance and Social Class

It was argued in Chapter 2 that, although a student's social class is potentially a relevant predictor of his academic performance, in reality a number of drawbacks such as competition from intercorrelated variables or difficulties of measurement reduce its worth as a predictor.

In this analysis we use a dichotomous measure of social class based on whether or not the student's fathers were employed in manual or non-manual occupations. At St Andrews, as Table 6:48 indicates, there are many more students from non-manual backgrounds, especially among GCE entrants.

This disparity means that it is not possible to make relevant comparisons for most subjects. Within this restriction, examination of Table 6:48 does not suggest that either the manual or non-manual group of students out-performs the other across the subjects as a whole.

In summary, it is fair to say that there is little evidence to suggest that knowledge of a student's personal characteristics can aid the prediction of his university performance at St Andrews. Any differences that do occur largely disappear after controlling for variations in school performance.

6.8 CONCLUSIONS

The chapter has been summarised during the text and lengthy summaries are unnecessary. In brief, this chapter has illustrated the differences in performance between SCE and GCE qualified students, and has demonstrated that the groups of students who experience the greater difficulty are those who have only Highers qualifications or who have poor SCE qualifications. Those GCE qualified students who perform badly over the academic year tend, perhaps due to their 'A' level background, to be more likely than their SCE contemporaries to successfully complete the year after resits.

There appear to be a number of reasons for these differences other than that GCE students have experienced a more academically specialised pedagogy. SCE students are more used to "teacher-directed" learning at school, less used to organising their own work, and less familiar with the teaching methods they will experience at university, which necessitates them making greater adjustments to their methods of learning than GCE students.

SCE students also find that their courses make greater demands on their ability and the amount they are required to work than is so for GCE students, this perhaps being due to a lack of knowledge of the techniques and theory they need.

What possible solutions are there to these problems? In order that the number of SCE qualified students who experience extreme difficulty is minimised, the university must ensure that SCE students are given the maximum opportunity to achieve their academic potential. This should be achieved through good, available counselling, both in the methods of study that are likely to be most profitable, and in making such decisions as choice of first year subjects. New students should be assisted to feel familiar in the departments in which they will study - for example, many SCE students report that they feel bewildered in large first year laboratories.

Those students who are most "at risk" should feel able to obtain assistance to ensure that they have a mastery of the concepts, theory and background that will be assumed by their courses. This should be achieved either formally through revision tutorials or informally through the students approaching their lecturers. On this latter count it is worrying that a much lower proportion of SCE than of GCE students (ref Section 6.6, page 255) felt able to approach any of their lecturers for help in either academic or personal problems.

To sum up, there are always likely to be differences between the first year performances of students from SCE and from GCE backgrounds, but these differences may be minimised by the university ensuring that new entrants feel both academically and socially relaxed in the minimum time.

	ARTS		SCIENCE	
	R	NR	R	NR
AAA	6	2	2	0
AAB	18	4	2	0
AAC/ABB	19	2	4	1
AAD/ABC/BB	26	0	5	0
AAE/ABC/ACC/BBC	21	12	13	0
AA/ABE/ACD/BBD/BBC	22	15	12	3
AB/ACE/BBE/BCD/ADD/CCC	16	11	10	9
AC/ADE/BCE/BDD/CCD/BB	9	10	12	8
AEE/BDE/CCE/CDD/AD/BC			10	7
BEE/CDE/DDD/AE/BD/CC	12	1	13	0
Others			11	3

(i) GCE QUALIFIED ENTRANTS

	ARTS		SCIENCE	
	R	NR	R	NR
AAAA	27	9	23	7
AAAB	16	14	17	8
AABB/AAAC	16	8	12	13
AABC/ABBB	18	20	20	10
BBBB/ABBC/AACC	10	12	12	14
BBBC/ABCC	2	4	4	7
BBCC/ACCC	0	1	1	5
BCCC	0	1		

(ii) SCE QUALIFIED ENTRANTS

Table 6:1 Academic Qualifications of Respondents (R) and Non-Respondents (NR) to survey of students opinions experiences of their first year at St. Andrews.

Table 6:2: Mean performance over the first two terms of all entrants to St Andrews in October 1976

Subject	Mean	SD	n	Range
English	56.14	5.73	106	37
Modern History	60.69	5.21	87	36
Mediaeval History	59.61	5.35	128	32
Philosophy	57.59	6.68	77	31
Fine Arts	54.57	4.96	63	25
French	57.77	5.36	155	47
German	57.93	6.71	80	44
Economics	58.58	8.76	74	41
Geography	59.81	5.11	63	22
Psychology	58.32	9.44	63	71
Geology	53.85	11.18	47	54
Astronomy	59.21	23.69	21	79
Botany	62.28	12.64	45	58
Chemistry	53.35	13.41	149	70
Physics 'A'	59.78	20.60	55	81
Physics 'B'	60.04	11.80	83	74
Zoology	49.52	10.26	95	51
Mathematics 'M'	62.28	21.00	138	91
Mathematics 'S'	58.69	20.04	72	82
Mathematics 'A'	63.33	22.44	131	95
Mathematics 'P'	65.74	18.13	76	77

NB In those subjects where assessment is over the year only, the figures relate to the overall mark

Table 6:3: Mean performance over the first two terms for respondents to sample

Subject	Mean	SD	n	Range
English	56.69	6.31	65	37
Modern History	60.84	5.69	51	36
Mediaeval History	59.78	5.65	74	32
Philosophy	58.92	6.58	48	27
Fine Arts	55.64	4.15	33	19
French	58.23	4.41	92	26
German	58.17	7.06	46	43
Economics	59.66	8.40	50	41
Geography	58.75	7.37	44	43.5
Psychology	57.63	10.37	43	67
Geology	56.68	10.72	30	54.5
Astronomy	61.68	20.01	19	78
Botany	62.39	12.20	31	51
Chemistry	55.04	11.44	97	56.5
Physics 'B'	61.04	10.92	47	74
Statistics 'B'	50.64	23.09	7	66.5
Mathematics 'M'	65.41	18.46	76	91.5
Mathematics 'S'	61.60	17.71	40	70
Mathematics 'A'	67.22	19.64	73	93.5
Mathematics 'P'	66.83	16.22	39	65.5

Table 6:4: Performance over year for respondents (R) and non-respondents (NR) to questionnaire

Subject		1st Rank	2nd Rank	PJ	FJ	n	X^2	Subject		1st Rank	2nd Rank	PJ	FJ	n	X^2
English	R	3	17	42	4	66	5.2	Astronomy	R	10	1	4	5	20	NC
	NR	1	6	29	5	41			NR	0	1	0	0	1	
Modern History	R	2	27	21	1	51	2.4	Botany	R	11	17	6	0	34	3.9
	NR	0	20	17	0	37			NR	1	7	3	1	12	
Mediaeval History	R	3	32	34	5	74	3.1	Chemistry	R	14	34	29	19	96	4.8
	NR	1	21	31	2	55			NR	7	13	17	16	53	
Philosophy	R	3	20	24	6	53	6.5	Physics 'B'	R	2	15	27	3	47	6.8
	NR	0	5	17	4	26			NR	2	11	17	6	36	
French	R	0	39	49	3	91	11.3	Zoology	R	7	10	30	8	55	1.3
	NR	3	19	40	2	64			NR	5	8	19	8	40	
German	R	2	19	23	3	47	1.3	Mathematics 'M'	R	27	21	18	14	80	12.1
	NR	2	11	19	3	35			NR	16	8	19	18	61	
Economics	R	6	36	13	10	65	10.8	Mathematics 'S'	R	11	17	8	5	41	16.9
	NR	3	7	11	4	25			NR	7	10	5	12	34	
Psychology	R	5	15	20	4	44	0.7	Mathematics 'A'	R	23	25	16	10	74	13.6
	NR	2	7	11	3	23			NR	22	10	18	16	60	
								Mathematics 'P'	R	16	10	13	4	43	17.4
									NR	9	4	13	10	36	

N.B. PJ: pass course after June degree examination

FJ: fail degree examination

Table 6:5: Comparison of respondents and non-respondents required to resit a course in September

Subject		Percentage required to resit	Number required to resit	Total number	Subject		Percentage required to resit	Number required to resit	Total number
English	R	6	4	66	Astronomy	R	25	5	20
	NR	13	5	41		NR	0	0	1
Modern History	R	2	1	51	Botany	R	0	0	34
	NR	0	0	37		NR	9	1	12
Mediaeval History	R	7	5	74	Chemistry	R	20	19	96
	NR	4	2	55		NR	31	16	53
French	R	3	3	91	Physics 'B'	R	6	3	47
	NR	3	2	64		NR	16	6	36
German	R	6	3	47	Zoology	R	15	8	55
	NR	9	3	35		NR	20	8	40
Economics	R	15	10	65	Mathematics 'M'	R	18	14	80
	NR	0	0	9		NR	30	18	61
Geography	R	7	3	45	Mathematics 'S'	R	12	5	41
	NR	5	1	20		NR	38	12	33
Psychology	R	2	2	44	Mathematics 'A'	R	14	10	74
	NR	5	5	23		NR	26	16	60
Geology	R	12	4	35	Mathematics 'P'	R	9	4	43
	NR	53	9	19		NR	30	10	36

Table 6:6: Mean Christmas performance of SCE and GCE qualified students

Subject	Mean		SD		n	
	Scot	Eng	Scot	Eng	Scot	Eng
Modern History	61.2	61.2	7.2	6.0	15	36
Mediaeval History	59.6*	62.1	4.2	3.9	25	49
Philosophy	54.1	54.9	6.2	7.7	14	34
Fine Arts	58.0	59.2	4.5	3.4	8	24
German	57.9	60.2	7.2	6.6	18	25
Economics	49.5	54.2	7.2	7.6	34	32
Geography	58.7	57.9	7.4	6.9	24	19
Psychology	51.6*	57.9	8.4	11.4	21	23
Geology	58.3*	50.1	9.5	19.6	19	11
Astronomy	48.5	63.5	25.9	17.8	8	11
Botany	64.7*	69.7	11.2	15.3	13	18
Chemistry	56.6	59.6	13.1	10.7	44	52
Physics 'A'	55.9	54.6	23.1	16.2	24	26
Physics 'B'	45.0	50.1	13.9	10.2	19	28
Zoology	62.9*	59.5	14.9	9.4	16	37
Mathematics 'M'	64.7	61.4	19.4	17.3	41	34
Mathematics 'S'	60.8	57.0	14.3	16.6	26	14
Mathematics 'A'	72.2	78.4	22.0	15.6	42	31
Mathematics 'P'	66.4	63.1	19.7	18.5	25	14

* denotes the difference between the mean SCE and the mean GCE performance is significant at the 5% level

Table 6:7: Mean Easter performance of SCE and GCE students

Subject	Mean		SD		n	
	Scot	Eng	Scot	Eng	Scot	Eng
Modern History	58.0	56.3	8.6	11.2	15	36
Mediaeval History	53.1	53.0	8.6	11.0	25	49
Philosophy	54.1	54.9	6.2	7.7	14	34
Fine Arts	59.5	58.6	2.3	3.4	8	24
German	57.4	59.9	5.7	5.1	18	28
Economics	49.5	54.2	7.2	7.6	34	32
Geography	60.6	60.5	3.7	5.2	24	20
Psychology	60.3	64.0	13.7	18.3	21	23
Geology	52.7	53.5	10.2	15.9	18	11
Astronomy	45.7	54.2	19.9	19.4	8	11
Botany	60.9	56.8	12.9	17.9	11	17
Chemistry	43.9	48.5	16.7	12.5	42	51
Physics 'A'	48.4	47.4	23.5	17.5	24	26
Physics 'B'	52.8	59.0	18.1	17.5	19	28
Zoology	45.6	46.5	10.8	13.5	31	20
Mathematics 'M'	65.1	66.3	22.9	18.9	41	33
Mathematics 'S'	67.1	64.9	19.2	14.1	26	13
Mathematics 'A'	59.8	63.1	20.6	16.1	41	29
Mathematics 'P'	68.7	66.9	17.2	15.9	25	14

Table 6:8 : Final classifications of first year performance (figures are percentages)

Subject		Merit/Rank	Pass	Resit	n	Subject		Merit/Rank	Pass	Resit	n
English	Scot	25	71	4	24	Astronomy	Scot	33 (n=3)	33 (n=3)	33 (n=3)	9
	Eng	33	60	7	42		Eng	55 (n=6)	27 (n=3)	18 (n=2)	11
Modern History	Scot	47	53	0	15	Botany	Scot	73	27	0	15
	Eng	61	36	3	36		Eng	89	11	0	19
Mediaeval History	Scot	36	56	8	25	Chemistry	Scot	52	25	23	44
	Eng	53	41	6	49		Eng	48	35	17	52
Philosophy	Scot	37	44	19	16	Physics 'A'	Scot	42	33	25	24
	Eng	46	46	8	37		Eng	27	42	31	26
French	Scot	36	57	7	42	Physics 'B'	Scot	21	63	16	19
	Eng	57	43	0	49		Eng	46	54	0	28
German	Scot	16	58	16	19	Zoology	Scot	22	50	28	18
	Eng	57	43	0	28		Eng	35	57	8	37
Economics	Scot	50	29	21	34	Mathematics 'M'	Scot	67	11	22	45
	Eng	81	10	9	31		Eng	52	37	11	35
Geography	Scot	88	8	4	25	Mathematics 'S'	Scot	82	7	11	27
	Eng	90	0	10	20		Eng	43	43	14	14
Psychology	Scot	24	67	9	21	Mathematics 'A'	Scot	65	19	16	43
	Eng	65	26	9	23		Eng	64	26	10	31
Geology	Scot	42	50	8	24	Mathematics 'P'	Scot	67	21	11	28
	Eng	36 (n=4)	46 (n=5)	18 (n=2)	11		Eng	47	47	7	15

Table 6:9: Correlations between performance at Christmas, Easter and June

Subject	CE	CJ	EJ
Modern History	29	55	83
Philosophy			64
German	42	66	67
Economics			82
Geography	42		
Psychology	32	17	84
Geology	73	73	77
Astronomy	86		
Botany	92		
Chemistry	63		
Physics 'A'	74	77	
Physics 'B'	51	47	66
Zoology	61	57	
Mathematics 'M'	67		
Mathematics 'S'	55		
Mathematics 'A'	71		
Mathematics 'P'	59		

NB Decimal points omitted

Modern History	WQ	62.3	61.3	Chemistry	WQ	56.5	62.0
	PQ	58.7	60.3		PQ	50.3	54.5
Mediaeval History	WQ	59.3	61.3	Physics 'B'	WQ	55.0	72.4
	PQ	57.2	58.5		PQ	59.3	62.3
German	WQ	56.6	60.2	Zoology	WQ	48.0	55.7
	PQ	51.0	not computed		PQ	42.0	48.1
Economics	WQ	57.6	62.6	Mathematics 'M'	WQ	71.3	74.6
	PQ	53.6	60.3		PQ	54.4	56.5
Geography	WQ	59.9	58.5	Mathematics 'S'	WQ	68.4	59.8
	PQ	56.7	59.6		PQ	48.3	60.7
Psychology	WQ	57.6	58.4	Mathematics 'A'	WQ	74.5	75.9
	PQ	53.5	59.4		PQ	46.5	63.2
				Mathematics 'P'	WQ	72.0	70.5
					PQ	56.6	65.8

Table 6:11: Mean performance at university of students as a function of the type of course they took in their last year at school

Subject	H6	SYSO	SYSH	'A' Level
English	53.5	57.5	55.3	57.4
Modern History	54.8	58.3	56.1	60.2
Mediaeval History	57.0	58.4	59.4	60.9
German	NC	NC	61.0	60.9
Economics	55.3	55.2	57.9	61.8
Geography	55.9	NC	59.6	59.2
Psychology	52.5	NC	57.1	59.1
Geology	NC	NC	56.2	61.5
Astronomy	NC	NC	64.2	65.5
Botany	51.6	NC	67.2	64.9
Chemistry	46.0	56.8	54.8	56.6
Physics 'A'	NC	NC	64.2	60.2
Physics 'B'	59.0	47.0	60.3	64.6
Zoology	45.1	45.8	47.8	51.4
Mathematics 'M'	60.0	64.5	68.7	64.8
Mathematics 'S'	54.0	53.6	67.1	57.2
Mathematics 'A'	63.7	59.4	69.7	68.8
Mathematics 'P'	56.0	63.3	71.1	62.9

NC: Not computed

NB 1. No means were calculated for those students who entered university straight from fifth year because of lack of numbers.

2. H6: Students who stayed at school for a sixth year but took only Highers

SYSO: Students who stayed at school for a sixth year and took only CSYS subjects

SYSH: Students who stayed at school for a sixth year and took both CSYS and Highers

Table 6:12: Performance in particular subjects of SCE students with or without the respective CSYS

Subject		Average Mark for Year
Chemistry	Higher only	48.4
	SYS	61.3
Physics	H	58.4
	SYS	74.0
Mathematical Methods	Higher Mathematics or SYS Mathematics Paper II or III	55.6
	SYS Maths Paper I	80.7
Mathematical Methods	Higher Mathematics or Mathematics Paper I or III	58.0
	SYS Maths Paper II	78.5
English	H	55.0
	SYS	58.0
French	H	54.6
	SYS	57.9
German	H	50.6
	SYS	62.0

Table 6:13: Correlation between school qualifications and university performance

Subject	SCE entrance score	GCE entrance score	Higher perf in university subject	GCE perf in university subject	Performance in CSYS in university subject
Economics	51 *	28		78 * (n=10)	
English	52 *	12	22	29 *	63 * (n=12)
Mediaeval History	64 *	37 *	42 *	03	31 (n=11)
German	29	29	23	69 *	nc
Modern History	34 *	00	10	nc	nc
Astronomy	42	40	nc	nc	nc
Botany	39	27	nc	nc	nc
Chemistry	44 *	39 *	44 39M[1]	47 *	48 *
Geography	29	11	-06	nc	nc
Geology	23	55	nc	nc	nc
Physics 'A'	74 *	63 *	73 *	63	43 (n=12)
Physics 'B'	05	37 *	nc	nc	nc
Psychology	26	-01	nc	nc	nc
Zoology	36	28	nc	nc	nc
Mathematics 'M'	56 *	71	66	32	MI 66 * MII 51 MIII 19
Mathematics 'S'	68	18	82	nc	MI 30 MII 53 * MIII 54 *
Mathematics 'A'	78 *	65 *	73	21	MI 37 MII 51 * MIII 44 *
Mathematics 'P'	61 *	28	67	nc	MI 37 MII 61 * MIII 62 *
French			16	52 *	73 *

* significant ($p < 0.05$)

1 Correlation between performance in Chemistry and school Mathematics

Table 6:14: Mean performance of those SCE and GCE students who performed well over the year and those who performed poorly

Subject	Students who performed well				Students who performed poorly			
	SCE	n	GCE	n	SCE	n	GCE	n
English	61.1	10	60.4	27	53.2	13	50.1	15
Modern History	62.2	13	62.5	30	54.0	2	52.0	6
Mediaeval History	60.9	19	61.5	44	53.2	6	48.2	5
Philosophy	59.6	12	59.7	33	NC		NC	
Fine Arts	58.6	5	58.4	14	52.3	3	51.7	11
French	59.5	21	60.5	43	52.7	21	54.7	6
German	60.6	11	61.2	23	47.8	7	53.2	5
Economics	60.7	15	65.4	22	48.9	8	48.9	5
Geography	61.6	7	61.5	17	52.9	7	40.5	3
Psychology	60.8	10	62.8	19	51.1	11	37.7	3
Geology	61.1	13	61.2	9	48.0	6	33.0	2
Astronomy	68.2	6	71.1	9	NC		NC	
Botany	62.9	12	67.7	15	NC		NC	
Chemistry	60.7	27	61.1	39	39.7	17	43.7	13
Physics 'A'	57.1	20	65.1	21	NC		NC	
Physics 'B'	58.9	16	64.8	28	NC		NC	
Mathematics 'M'	75.5	31	70.9	28	36.5	11	40.5	6
Mathematics 'S'	70.3	21	64.7	12	NC		NC	
Mathematics 'A'	73.3	41	74.9	18	27.0	7	41.3	6
Mathematics 'P'	74.2	22	69.2	11	31.0	3	40.0	3

NC: Not computed

Table 6.16: Mean responses to questions regarding methods of teaching and learning at school

Method	H5	H6	SYSH	SYSO	GCE
Dictated notes	3.03	3.40	3.03	2.77	3.13
Own notes	2.93	2.40	2.74	3.29	3.47
Duplicated notes	2.53	2.40	2.78	2.20	2.43
Exercises	3.30	3.25	3.67	3.46	3.69
Essays	2.37	2.35	2.99	2.85	3.28
Reading	2.60	2.40	3.33	3.43	3.46
Class/group discussion	1.97	1.90	2.75	3.17	2.98
Laboratory work	2.30	2.05	2.56	2.49	2.76

Table 6:17: Mean responses to questions regarding methods of teaching and learning at university

Method	H5	H6	SYSH	SYSO	GCE
Dictated notes	2.17	1.95	2.69	2.94	2.46
Own notes	3.73	3.60	4.05	4.06	4.05
Duplicated notes	2.30	2.30	2.50	2.57	2.52
Exercises	2.30	1.95	3.42	3.34	2.93
Essays	3.00	2.75	3.19	2.74	2.94
Reading	3.03	3.35	3.86	3.69	3.77
Class/group discussion	2.50	2.40	3.47	3.43	3.28
Laboratory work	2.57	2.95	2.66	2.54	2.78

Table 6:18: Transition indices for change in methods of learning between school and university

Method	Arts		Science	
	SCE	GCE	SCE	GCE
Exercises	-0.28	-0.37	-0.19	-0.38
Dictated notes	-0.39	-0.27	0.10	-0.18
Duplicated notes	-0.23	+0.09	-0.05	0.08
Own notes	0.62	0.21	0.60	0.29
Reading	0.44	0.25	0.26	0.23
Class/group discussion	0.43	0.31	0.45	0.26
Essays	0.52	0.01	-0.39	-0.47
Laboratory work			0.26	0.04

Table 6:19: Transition indices for SCE and GCE students as a function of the type of course taken in the last year at school

Method	H5	H6	SYS	GCE
Exercises	-0.59	-0.27	-0.19	-0.37
Duplicated notes	-0.31	-0.10	-0.34	-0.09
Dictated notes	-0.38	0.00	-0.16	-0.22
Own notes	+0.43	0.53	0.67	0.24
Reading	+0.17	0.27	0.33	0.25
Class/group discussion	+0.36	0.27	0.48	0.29
Essays	+0.24	0.27	0.28	-0.18

Table 6:20: Mean responses to questions regarding methods of study at school by the type of course taken in the last year at school

Method		H5	H6	SYSH	SYSO	GCE
Dictated notes	A	2.33 (9)	1.50 (2)	2.59 (66)	2.60 (15)	2.69 (141)
	S	3.55 (9)	3.10 (10)	3.59 (64)	2.61 (13)	3.60 ((90) c
Own notes	A	3.67	2.0	3.09	3.60	3.75
	S	2.11	2.30	2.42	3.31	3.22
Duplicated notes	A	2.89	4.0	2.75	2.07	2.31
	S	3.11	2.9	3.00	2.15	2.50
Exercises	A	4.56	5.00	3.92	4.00	3.73
	S	3.67	4.10	3.60	3.54	3.80
Essays	A	3.33	3.50	3.69	3.73	4.06
	S	2.22	2.80	2.39	2.62	2.43
Reading	A	3.44	3.50	3.97	3.80	3.94
	S	2.55	3.00	2.86	3.38	3.01
Class/group discussion	A	3.11	3.00	3.05	3.66	3.33
	S	1.77	2.80	2.58	2.84	2.63
Laboratory work	A	2.44	2.5	1.53	1.20	1.72
	S	2.44	2.9	3.73	3.62	3.87

Table 6:21: Responses to questions regarding the difficulty of various dimensions of Chemistry

		Easy %	So-so %	Hard %
"TECHNIQUES", eg syntax, grammar, formulae, writing, experimental skills	Eng	56	25	19
	Scot	31	29	40
"CONCEPTS", theory or general approach	Eng	57	22	21
	Scot	21	33	46
"AMOUNT OF WORK"	Eng	50	26	24
	Scot	16	25	59
Demands on your "MEMORY"	Eng	33	27	40
	Scot	12	26	62
Demands on your "ABILITY"	Eng	50	37	13
	Scot	28	31	41
Demands on your capacity to get on with it by "YOURSELF"	Eng	49	25	26
	Scot	29	31	40
Recognising the required "ACADEMIC QUALITIES"	Eng	43	26	31
	Scot	23	42	35
"PRACTICAL PROBLEMS"	Eng	67	22	11
	Scot	50	31	19

Table 6:22: Difficulty of a course: Physics

		Easy %	So-so %	Hard %
"TECHNIQUES", eg syntax, grammar, formulae, writing, experimental skills	Eng	37	29	34
	Scot	13	36	51
"CONCEPTS", theory or General approach	Eng	39	32	27
	Scot	27	30	43
"AMOUNT OF WORK"	Eng	40	28	32
	Scot	7	53	40
Demands on your "MEMORY"	Eng	37	25	38
	Scot	21	26	53
Demands on your "ABILITY"	Eng	26	47	27
	Scot	15	36	49
Demands on your capacity to get on with it by "YOURSELF"	Eng	31	27	42
	Scot	18	33	49
Recognising the required "ACADEMIC QUALITIES"	Eng	31	41	28
	Scot	13	53	34
"PRACTICAL PROBLEMS"	Eng	64	25	11
	Scot	41	41	18

N.B. Due to rounding percentages to the nearest whole number, some of the percentages quoted in the following tables do not add exactly to 100.

Table 6:23: Mean difficulty of those SCE and GCE students who performed well and those who performed poorly

			Psych	Eng	Econ	Mod Hist	French	German	Chem	Zool
TECHNIQUES	Scot	Good	2.80	2.89	3.53	2.76	3.28	3.40	3.15	2.83
		Poor	3.27	3.31	3.20		3.39	4.40	3.52	3.27
	Eng	Good	2.27	2.50	2.30	2.35	2.63	3.00	2.66	2.47
		Poor	2.50	2.84	3.00	4.00	2.50	4.00	2.91	3.06
CONCEPTS	Scot	Good	2.40	2.55	3.67	2.38	3.00	3.30	3.00	2.50
		Poor	2.81	3.38	3.20		3.05	3.20	3.88	3.18
	Eng	Good	2.33	2.38	2.85	2.03	2.50	2.60	2.66	1.90
		Poor	2.25	2.84	3.33	3.00	3.00	3.00	2.91	2.93
AMOUNT OF WORK	Scot	Good	2.80	3.44	2.60	3.07	3.76	3.20	3.42	3.83
		Poor	3.00	3.53	2.47		3.50	3.40	3.93	3.70
	Eng	Good	2.61	2.50	2.05	2.46	2.73	2.14	2.79	2.65
		Poor	2.25	2.61	2.67	3.83	2.50	2.60	3.00	3.18
MEMORY	Scot	Good	3.40	2.22	3.27	2.84	3.04	2.90	3.46	4.16
		Poor	3.81	3.07	3.27		3.11	3.60	4.41	4.18
	Eng	Good	3.00	2.07	2.70	2.42	2.47	2.47	3.26	3.35
		Poor	3.25	1.76	3.33	3.33	3.00	3.40	3.82	4.12
ABILITY	Scot	Good	2.80	3.55	3.20	2.92	3.95	3.50	3.15	3.09
		Poor	3.00	3.83	2.93		3.72	4.20	3.23	3.16
	Eng	Good	2.67	3.07	2.60	2.42	2.94	2.80	2.58	2.35
		Poor	2.50	3.50	3.33	3.00	3.50	4.00	3.25	3.00
YOURSELF	Scot	Good	2.90	3.11	3.00	2.92	2.80	2.50	3.03	3.83
		Poor	3.00	3.46	3.06		3.72	3.60	3.58	3.36
	Eng	Good	1.94	2.88	2.55	3.00	2.73	2.27	2.74	2.50
		Poor	3.50	3.69	3.83	3.33	3.75	3.20	3.72	3.50
ACADEMIC QUALITIES	Scot	Good	3.20	3.66	3.27	3.00	3.62	3.50	3.31	3.00
		Poor	3.36	4.07	3.20		3.77	4.20	3.35	3.45
	Eng	Good	3.11	3.30	2.85	3.11	3.13	2.47	2.92	3.10
		Poor	3.25	4.07	3.00	3.40	3.25	3.20	3.12	3.56

Table 6:24: Difficulty of a first year course: Zoology

		Easy %	So-so %	Hard %
Techniques	Scottish	31	35	34
	English	46	26	28
Concepts	Scottish	38	35	27
	English	62	22	16
Amount of work	Scottish	24	8	6.7
	English	36	35	29
Demands on memory	Scottish	4	31	65
	English	15	24	61
Demands on ability	Scottish	31	35	34
	English	49	31	20
Demands on need to work by oneself	Scottish	19	19	62
	English	36	29	35
Ease of recognising required academic qualities	Scottish	31	35	34
	English	27	22	51
Practical problems	Scottish	54	23	23
	English	51	24	25

Table 6:25: Difficulty of a first year course: Botany

		Easy %	So-so %	Hard %
Techniques	Scottish	29	53	18
	English	68	26	6
Concepts	Scottish	35	53	12
	English	79	11	10
Amount of work	Scottish	19	50	31
	English	63	16	21
Demands on memory	Scottish	12	29	59
	English	21	47	32
Demands on ability	Scottish	24	53	23
	English	72	17	11
Demands on need to work by oneself	Scottish	29	24	47
	English	61	17	22
Ease of recognising required academic qualities	Scottish	24	53	23
	English	53	46.5	0.5
Practical problems	Scottish	82	12	6
	English	63	26	11

Table 6:26: Difficulty of a first year course: Mathematics Methods

		Easy %	So-so %	Hard %
Techniques	Scottish	52	37	11
	English	32	47	21
Concepts	Scottish	52	26	22
	English	37	32	31
Amount of work	Scottish	41	30	29
	English	37	42	21
Demands on memory	Scottish	44	22	34
	English	37	21	42
Demands on ability	Scottish	52	37	11
	English	26	42	32
Demands on need to work by oneself	Scottish	48	33	19
	English	26	42	32
Ease of recognising required academic qualities	Scottish	41	33	26
	English	37	47	16
Practical problems	Scottish	66	26	8
	English	53	32	15

Table 6:27: Difficulty of a first year course: Applied Mathematics

		Easy %	So-so %	Hard %
Techniques	Scottish	41	34	25
	English	22	50	28
Concepts	Scottish	38	25	37
	English	44	33	23
Amount of work	Scottish	28	38	34
	English	22	67	11
Demands on memory	Scottish	28	38	34
	English	39	28	33
Demands on ability	Scottish	31	41	28
	English	17	44	39
Demands on need to work by oneself	Scottish	31	38	31
	English	39	28	33
Ease of recognising required academic qualities	Scottish	37	38	25
	English	39	39	22
Practical problems	Scottish	66	32	2
	English	61	22	17

Table 6:28: Difficulty of a first year course: Psychology

		Easy %	So-so %	Hard %
Techniques	Scottish	27	50	23
	English	50	39	11
Concepts	Scottish	50	30	20
	English	62	17	21
Amount of work	Scottish	27	60	13
	English	32	50	18
Demands on memory	Scottish	27	20	53
	English	28	38	36
Demands on ability	Scottish	37	50	13
	English	51	28	21
Demands on need to work by oneself	Scottish	34	41	25
	English	61	21	18
Ease of recognising required academic qualities	Scottish	23	30	47
	English	24	34	42
Practical problems	Scottish	47	23	30
	English	41	41	18

Table 6:29: Difficulty of a first year course: Economics

		Easy %	So-so %	Hard %
Techniques	Scottish	23	41	36
	English	31	45	24
Concepts	Scottish	21	36	43
	English	34	32	34
Amount of work	Scottish	51	38	11
	English	56	38	6
Demands on memory	Scottish	26	31	43
	English	34	47	19
Demands on ability	Scottish	31	44	25
	English	34	34	32
Demands on need to work by oneself	Scottish	36	33	31
	English	46	22	31
Ease of recognising required academic qualities	Scottish	26	41	33
	English	34	34	32
Practical problems	Scottish	41	41	18
	English	37	43	20

Table 6:30: Difficulty of a first year course: Geography

		Easy %	So-so %	Hard %
Techniques	Scottish	25	48	27
	English	38	35	27
Concepts	Scottish	22	39	39
	English	27	31	42
Amount of work	Scottish	11	11	78
	English	8	27	65
Demands on memory	Scottish	18	46	36
	English	31	38	31
Demands on ability	Scottish	14	29	57
	English	24	40	36
Demands on need to work by oneself	Scottish	29	14	57
	English	20	32	48
Ease of recognising required academic qualities	Scottish	14	29	57
	English	19	27	54
Practical problems	Scottish	43	32	25
	English	42	23	35

Table 6:32: Difficulty of a first year course: English

		Easy %	So-so %	Hard %
Techniques	Scottish	30	30	40
	English	54	20	26
Concepts	Scottish	27	30	43
	English	52	33	15
Amount of work	Scottish	6	53	41
	English	50	28	22
Demands on memory	Scottish	37	47	16
	English	75	19	6
Demands on ability	Scottish	7	31	62
	English	26	39	35
Demands on need to work by oneself	Scottish	27	23	50
	English	32	26	42
Ease of recognising required academic qualities	Scottish	10	20	70
	English	23	19	58
Practical problems	Scottish	43	30	27
	English	49	23	28

Table 6:33: Difficulty of a first year course: Modern History

		Easy %	So-so %	Hard %	
Techniques	Scottish	24	53	23	n=21
	English	50	25	25	n=44
Concepts	Scottish	43	53	4	
	English	61	30	9	
Amount of work	Scottish	24	43	33	
	English	36	39	25	
Demands on memory	Scottish	24	38	38	
	English	39	36	25	
Demands on ability	Scottish	14	53	33	
	English	41	34	25	
Demands on need to work by oneself	Scottish	29	43	28	
	English	41	23	36	
Ease of recognising required academic qualities	Scottish	14	48	38	
	English	34	23	43	
Practical problems	Scottish	28	19	53	
	English	29	25	46	

Table 6:34: Difficulty of a first year course: Mediaeval History

		Easy %	So-so %	Hard %
Techniques	Scottish	22	66	12
	English	46	33	21
Concepts	Scottish	44	52	4
	English	53	30	17
Amount of work	Scottish	37	52	11
	English	35	40	25
Demands on memory	Scottish	14	50	36
	English	21	44	35
Demands on ability	Scottish	11	61	28
	English	30	40	30
Demands on need to work by oneself	Scottish	32	43	25
	English	39	30	31
Ease of recognising required academic qualities	Scottish	11	50	39
	English	32	32	36
Practical problems	Scottish	32	21	47
	English	19	37	44

Table 6:35: Difficulty of a first year course: Fine Arts

		Easy %	So-so %	Hard %
Techniques	Scottish	36	36	28
	English	32	48	20
Concepts	Scottish	46	27	27
	English	51	26	23
Amount of work	Scottish	9	64	27
	English	52	19	29
Demands on memory	Scottish	9	36	55
	English	23	32	45
Demands on ability	Scottish	9	73	18
	English	45	23	32
Demands on need to work by oneself	Scottish	36	36	28
	English	45	32	23
Ease of recognising required academic qualities	Scottish	18	45	37
	English	29	35	36
Practical problems	Scottish	18	45	37
	English	54	23	23

Table 6:36: Difficulty of a first year course: Philosophy

		Easy %	So-so %	Hard %	
Techniques	Scottish	12	24	64	n=17
	English	22	29	49	n=42
Concepts	Scottish	12	30	58	
	English	29	22	49	
Amount of work	Scottish	36	48	16	
	English	58	39	3	
Demands on memory	Scottish	36	54	10	
	English	53	40	7	
Demands on ability	Scottish	18	24	58	
	English	26	40	34	
Demands on need to work by oneself	Scottish	48	24	28	
	English	58	22	20	
Ease of recognising required academic qualities	Scottish	6	12	82	
	English	22	17	61	
Practical problems	Scottish	36	18	46	
	English	40	37	24	

Table 6:37: Difficulty of a first year course: French

		Easy %	So-so %	Hard %
Techniques	Scottish	15	58	27
	English	40	44	16
Concepts	Scottish	32	40	28
	English	48	38	14
Amount of work	Scottish	7	38	55
	English	34	50	16
Demands on memory	Scottish	27	44	29
	English	40	56	4
Demands on ability	Scottish	2	31	67
	English	20	50	30
Demands on need to work by oneself	Scottish	25	31	44
	English	40	30	30
Ease of recognising required academic qualities	Scottish	4	29	67
	English	34	18	48
Practical problems	Scottish	50	31	19
	English	58	24	18

Table 6:38: Difficulty of a first year course: German

		Easy %	So-so %	Hard %
Techniques	Scottish	15	35	50
	English	25	29	46
Concepts	Scottish	10	45	45
	English	37	46	17
Amount of work	Scottish	15	30	55
	English	52	26	22
Demands on memory	Scottish	35	30	35
	English	29	50	21
Demands on ability	Scottish	0	30	70
	English	30	30	40
Demands on need to work by oneself	Scottish	40	40	20
	English	42	38	20
Ease of recognising required academic qualities	Scottish	10	15	75
	English	37	29	34
Practical problems	Scottish	55	20	25
	English	66	25	9

TABLE 6 : 39 MEDIAN DIFFERENCES BETWEEN SCE AND GCE QUALIFIED STUDENTS ON THE EXTENT TO WHICH THEY FOUND VARIOUS DIMENSIONS OF THEIR COURSES DIFFICULT CLASSIFIED BY SUBJECT GROUPS.

	CHEM/ PHYS	BIOL	MATHS	SOC. SCI.	ARTS	LANG	ALL
Techniques	19	9	6	12	9	7.5	10.5
Concepts	20.5	6.5	11.6	9	9	21	10
Amount of Work	21.5	22.5	16	7	14	36	12
Demands on Memory	18.5	15.5	4.5	10	10	19.5	12
Demands on Ability	30.0	13	16	21	14	33.5	12
Demands on Need to Work Alone	11.5	26	2.5	8	8	7	7.5
Ease of Recognising Required Academic Quals.	5	19	6.5	3	5	30	5
Practical Problems	7.5	2.5	11	2	7	8.5	5

Table 6:40: Proportions of Science students finding university stimulating, academically and socially

(i) Academically stimulating				
	Overall Performance			
	First quartile	Second quartile	Third quartile	Fourth quartile
SCE	95	62	83	77
GCE	75	88	76	35
(ii) Socially stimulating				
	Overall Performance			
	First quartile	Second quartile	Third quartile	Fourth quartile
SCE	81	69	89	81
GCE	86	61	76	86

Table 6:41: Proportions of students expressing familiarity with the teaching methods

Subject		Most/All %	Some/None %	n	χ^2	Subject		Most/All %	Some/None %	n	χ^2
English	Scot	80	20	30	0.02	Geology	Scot	39	61	28	1.92
	Eng	81	19	47			Eng	56	44	16	
Modern History	Scot	81	19	21	0.28	Botany	Scot	50	50	16	3.54
	Eng	86	14	44			Eng	69	31	18	
Mediaeval History	Scot	65	35	28	8.18	Chemistry	Scot	78	22	59	4.71
	Eng	82	18	57			Eng	87	13	100	
Philosophy	Scot	34	66	18	5.25	Physics 'B'	Scot	47	54	39	31.31
	Eng	50	50	42			Eng	82	18	58	
French	Scot	81	19	47	4.01	Zoology	Scot	48	52	27	17.53
	Eng	92	8	50			Eng	76	24	55	
German	Scot	75	25	20	2.00	Mathematics 'M'	Scot	60	40	20	0.00
	Eng	87	13	24			Eng	60	40	15	
Economics	Scot	48	52	38	1.05	Mathematics 'A'	Scot	39	61	26	2.66
	Eng	49	51	31			Eng	71	29	14	
Geography	Scot	78	22	28	0.70	Mathematics 'P'	Scot	50	50	22	1.28
	Eng	87	13	27			Eng	28	72	7	
Psychology	Scot	27	73	30	9.31	Mathematics 'S'	Scot	45	55	18	4.05
	Eng	52	48	29			Eng	78	22	9	

	SCE						GCE					
	FAMILIAR			UNFAMILIAR			FAMILIAR			UNFAMILIAR		
	MEAN	S.D.	n	MEAN	S.D.	n	MEAN	S.D.	n	MEAN	S.D.	n
JUNE MARKS												
Economics	61.0	3.0	8	54.6	8.9	12	63.5	11.1	11	61.4	7.1	11
English	57.0	5.5	18	55.3	1.9	4	56.5	7.6	33	58.5	4.0	6
German	58.7	5.7	10	55.6	7.6	5	59.5	4.8	18	58.5	4.9	2
French	56.5	4.0	29	55.7	4.2	9	59.8	3.2	38	59.7	1.3	4
Medl History	60.1	5.4	16	56.8	3.7	8	60.0	6.4	39	61.1	4.4	7
Modn History	61.4	5.5	14	60.2	4.4	6	69.8	6.3	29	57.0		1
Philosophy	56.2	8.2	5	59.4	6.7	8	61.2	7.9	13	58.7	4.9	17
Psychology	57.0	6.7	5	55.3	6.5	16	61.1	5.8	10	57.7	17.8	11
CHRISTMAS MARKS												
Botany	64.0	14.7	5	55.2	10.4	5	62.5	14.6	11	38.5	18.1	4
Chemistry	57.3	13.5	33	54.1	12.8	10	60.6	10.7	43	55.0	10.5	8
Geology	61.2	7.2	5	58.2	7.2	17	59.7	3.7	7	57.9	8.2	10
Geography	57.8	9.4	6	58.5	9.9	13	60.2	13.3	5	40.0	26.5	4
Zoology	46.2	17.4	6	39.4	11.8	9	48.5	10.7	27	44.6	10.5	9
Maths 'M'	64.4	17.4	9	59.4	21.3	5	61.5	21.8	8	53.0	15.4	5
Maths 'S'	60.0	10.2	6	52.4	19.3	8	48.8	10.2	6	45.0		2
Maths 'A'	75.3	20.2	9	68.4	19.9	11	79.0	14.1	10	75.3	14.2	3
Maths 'P'	76.2	12.5	9	55.3	21.5	6	64.0		2	45	19.9	4
EASTER MARKS												
Botany	67.6	11.8	7	57.2	3.4	5	75.6	8.7	11	58.2	22.6	5
Chemistry	45.8	18.2	31	38.3	11.1	10	50.0	11.7	42	43.6	14.0	8
Geology	61.8	3.3	5	60.4	3.9	17	62.7	3.7	7	60.7	5.2	10
Geography	53.8	10.8	5	52.2	10.3	13	58.6	11.3	5	44.8	22.7	4
Maths 'M'	61.9	16.6	9	56.4	18.9	5	69.6	22.4	8	55.4	16.7	5
Maths 'S'	69.3	12.2	6	58.0	26.0	8	62.4	20.9	5			
Maths 'A'	60.0	15.3	9	53.9	20.3	11	60.3	20.1	10	64.5		2
Maths 'P'	75.0	10.7	9	62.3	24.2	6	56.5		2	66.3	20.8	4

TABLE 6 : 42 PERFORMANCE OF STUDENTS WHO FOUND THE TEACHING TECHNIQUES FAMILIAR OR UNFAMILIAR.

Table 6:43: Replies of those students who entered with Highers alone to the question regarding the amount of the work they had previously covered

Subject		Most or all	Quite a lot	Some	Little or none but no gap	Little or none but a gap
Latin	n	0	0	5	2	1
	%	0	0	62.5	25	12.5
Music	n	0	2	1	2	0
	%	0	40	20	40	0
Spanish	n	0	0	1	4	2
	%	0	0	14	57	29
French	n	1	5	23	14	4
	%	2	11	49	30	8
German	n	0	3	10	4	3
	%	0	15	50	20	15
Greek	n	0	0	2	2	0
	%	0	0	50	50	0
Chemistry	n	0	1	5	10	2
	%	0	5	28	55	11
Statistics 'B'	n	0	4	2	6	0
	%	0	33	17	50	0
Mathematics 'M'	n	4	10	4	1	1
	%	20	50	20	5	5
Mathematics 'P'	n	0	5	10	4	3
	%	0	22	45	18	13
Mathematics 'A'	n	2	2	11	5	3
	%	7	20	43	20	10
Mathematics 'S'	n	0	1	5	10	2
	%	0	5	28	55	11

Table 6:44: Mean responses of SCE students to inventory of study habits by type of course taken in last year at school

	Left after fifth year	Sixth year, Highers only	Sixth year CSYS
Study regular times each day	6.38	5.10	6.26
Put off work until last minute	5.10	5.67	6.22
Experience difficulty working for more than one hour at a time	4.03	4.00	4.23
Experience difficulty organising work	4.14	4.95	4.07
Easily distracted	5.45	5.86	5.79
Without exams, would not study very much	5.24	4.83	5.07
Try to revise every topic for examinations	6.51	5.50	6.05

Mean responses of GCE students to inventory of study habits.

Study regular times each day	5.2	Easily distracted	5.6
Put off work until last minute	5.3	Without exams,would not study very much	4.8
Experience difficulty working for more than one hour at a time	3.9	Try to revise every topic for examinations	5. 4
Experience difficulty organising work	3.8		

Table 6:46: Partial correlations between age and performance controlling for ability

Subject	SCE	GCE
English	-0.06	-0.07
Modern History	-0.14	-0.14
Mediaeval History	-0.08	-0.09
Philosophy	-0.07	-0.07
French	0.37	0.33
German	0.02	0.01
Economics	0.19	0.15
Geography	0.12	0.11
Psychology	-0.06	-0.07
Geology	-0.10	-0.15
Botany	0.09	0.06
Chemistry	-0.02	-0.05
Physics 'B'	-0.20	-0.22
Mathematics 'M'	-0.20	-0.29
Mathematics 'S'	0.24	0.16
Mathematics 'A'	-0.07	-0.10
Mathematics 'P'	-0.09	-0.10

Table 6:47: Comparison of performance by sex and nationality

Subject		Mean Scot	Mean Eng	Subject		Mean Scot	Mean Eng	Subject		Mean Scot	Mean Eng
English	M	57.8	57.6	Geography	M	58.9	54.6	Zoology	M	45.7	50.6
	F	56.2	56.5		F	59.1	62.3		F	45.1	53.4
Modern History	M	NC (n=3)	62.7	Psychology	M	54.3	62.0	Mathematics 'M'	M	64.1	60.5
	F	59.6	58.7		F	56.1	58.3		F	69.3	74.5
Mediaeval History	M	61.0	61.1	Geology	M	56.0	57.4	Mathematics 'S'	M	63.3	50.6
	F	58.7	59.8		F	59.6	57.3		F	62.8	65.0
Philosophy	M	NC (n=3)	58.7	Botany	M	57.9	62.1	Mathematics 'A'	M	65.8	64.3
	F	59.6	60.9		F	65.3	65.3		F	64.7	77.9
French	M	55.5	59.3	Chemistry	M	54.2	56.5	Mathematics 'P'	M	70.8	57.4
	F	56.2	60.2		F	48.0	58.0		F	65.1	68.3
German	M	NC (n=1)	58.9	Physics 'A'	M	62.3	60.2				
	F	57.4 (n=17)	60.4		F	65.5	60.2				
Economics	M	54.8	60.6	Physics 'B'	M	56.0	65.5				
	F	57.7	64.4		F	54.2	64.3				

Table 6:48: Comparison of performance of students from manual and non-manual backgrounds

Subject		Mean Scot	Mean Eng	Subject		Mean Scot	Mean Eng	Subject		Mean Scot	Mean Eng
English	NM	57.2	56.6	Geography	NM	60.3	58.5	Zoology	NM	44.3	51.4
	M	53.0	57.8		M	55.7	58.3		M	48.3	54.4
Modern History	NM	61.4	61.1	Psychology	NM	54.5	59.2	Mathematics 'M'	NM	64.8	65.8
	M		58.4		M	60.2	61.0		M	68.5	63.7
Mediaeval History	NM	59.7	60.3	Geology	NM	56.9	55.8	Mathematics 'S'	NM	61.1	57.1
	M	59.0 (n=1)	59.0		M	55.6	65.0		M	70.1	67.8
Philosophy	NM			Botany	NM	65.6	61.2	Mathematics 'A'	NM	65.2	70.2
	M				M	53.4	73.5		M	66.2	69.8
French	NM	56.7	59.6	Chemistry	NM	52.9	56.3	Mathematics 'P'	NM	68.1	62.9 (n=2)
	M	54.3	61.8		M	52.7	58.5		M	71.8	
German	NM	58.1	60.0	Physics 'A'	NM	64.1	59.6				
	M	54.7	60.3		M	60.3	63.3				
Economics	NM	55.7	62.1	Physics 'B'	NM	55.8	63.0				
	M	58.5	63.8		M	54.8	70.2				

CHAPTER 7

A STUDY OF THE REASONS FOR CHOOSING AN HONOURS OR AN ORDINARY DEGREE

The present structure of degree awarding in Scottish universities (the "general" ordinary and "specialised" honours) dates from the early twentieth century. For many years a greater proportion of students took an Ordinary degree (eg in 1953/54, 63.7 per cent of males and 72.7 per cent of females). However, this trend has changed recently, a fact attributed by McPherson (1973) to be primarily due to the increase in English Honours graduates which has limited a number of the traditional career channels of Scots graduates. He argues that in the 1930s one in four British graduates were Scots whereas the proportion in the early 1970s was nearer one in ten. Furthermore, there is an increasing tendency for those Scots who take Honours degrees to leave Scotland, while those who take Ordinary degrees stay.

The effect of this shift in the type of degree awarded was such that of those students who entered Edinburgh University in 1971 only 12.3 per cent of males and 27.3 per cent of females actually wanted to take an Ordinary degree. However, McPherson (1973) reports that in the Faculties of Arts and Pure Science in 1973, around 66 per cent of females and 33 per cent of males took an Ordinary.

In Chapter 4 we derived a scoring system for university performance. In it, the score assigned to an Ordinary degree was greater than that assigned to a third class Honours for SCE qualified students but not for GCE qualified students. In this chapter we will attempt to explain this result by comparing the proportions of students who took an Ordinary degree by choice with those who did so as a result of academic failure at some stage of their university career.

The main method used was a survey of the cohort of students who entered St Andrews in October 1976. Each student received a short questionnaire in May 1978 prior to sitting the examinations at the end of their second year. There were two reasons for undertaking the survey at this time. Firstly, to improve the estimation of the proportion of students who were taking an Ordinary by choice, it was essential that the questionnaire was distributed prior to the examinations. Secondly, those students who aspired to an Honours degree were asked to estimate their chances of being accepted onto an Honours course. This, too, needed to be asked before the examinations.

The disadvantages of administering the questionnaire at this time were that many students were likely to be very busy with examinations and thus not predisposed to responding. Also, some Arts students were exempt from degree examinations and may have left St Andrews. The first problem was helped by constructing a very short questionnaire and the second by sending the questionnaire to the students' homes when it could be ascertained that they had left St Andrews.

The questionnaire comprised four different sections, only one of which was to be answered by each student. These were: Honours: Honours (this comprised those students who had intended on entry to take an Honours degree, and still did so); Honours:Ordinary; Ordinary: Honours and Ordinary:Ordinary. Most interest in the study was in those students who had intended or were intending to take an Ordinary. These students were asked to tick any of a number of statements which may have been associated with their choice of degree. Honours students were asked only to estimate their chances of being accepted onto an Honours course. The full questionnaire appears in Appendix C.

7.1 RESULTS

The questionnaires were distributed and returned by mail. Those students who did not reply received a personal "call back" and a reminder note. The full sample comprised 614 students of whom 404 replied. The non-respondents were made up as follows: 180 "true" non-respondents; 14 students who later failed with no successes in their second year, these could be interpreted as students who had already accepted that they would fail and thus did not find the questionnaire relevant; 5 who had neither SCE nor GCE qualifications and 11 whose inclusion in the sample was due to errors in the sampling frame. As we are interested here only in those students who complete a degree, we have effectively a "true response rate" of 404/584 (69.2 per cent). The reasons for this somewhat disappointing response rate have been described above. Another is that this cohort had received, during their academic careers, a large number of questionnaires relating to their performance and experiences at university. It was apparent that some students were a little resentful of receiving another questionnaire.

It is necessary to make an important caveat here. The results presented in this chapter are open to potential bias not only as a result of the significant difference between the structure of the respondents and non-respondents. Many Arts students already knew the courses they would be taking in their third year and so their replies may be subject to recall errors.

The distributions of the respondents and non-respondents are displayed respectively in Table 7:1. There is a significant difference at the 0.5 per cent level between the two groups. This is caused primarily by the high response rate of the SCE qualified male Arts students and the low response rates among SCE qualified male Scientists and GCE qualified male Arts students.

Table 7.2 demonstrates that, at St Andrews, there has been a continuation of the trend away from the Ordinary degree. Of those students who had successfully completed two years at university, only 14.34 per cent were taking an Ordinary degree (10.8 per cent of males and 18.1 per cent of females). The students taking an Ordinary have

Table 7:1: Response to survey on ordinary degrees

	Arts		Science		
	Male	Female	Male	Female	
Respondents					
SCE	22	67	53	27	169
GCE	47	64	56	23	190
Both	10	13	10	7	40
Total	79	144	119	57	399
Non-respondents					
SCE	3	25	35	10	73
GCE	32	35	17	10	94
Both	1	6	3	3	13
Total	36	66	55	23	180

N.B. Five responses could not be used as they were returned blank or uninterpretable.

been divided into two groups: those who have attained sufficient passes to graduate after three years and those who require four or more years to complete a degree. The former are likely to have taken an Ordinary degree by choice, while the latter will certainly have failed some examinations. There is a clear national difference. Of those SCE students taking an Ordinary, 71 per cent graduated in three years as opposed to only 46 per cent of GCE students.

We will now consider the responses of the students in each of the four groups of the questionnaire:

(1) . Honours:Honours

We consider initially the group of students who intended on entry to pursue an Honours course and still did so. In all, 89.3 per cent of the respondents wished to take an Honours course and 87.5 per cent did so, the remaining 1.8 per cent attempting either an Ordinary in four years or Honours in five.

Table 7:3 displays the replies to the question which asked the students to estimate their chances of gaining admittance to an Honours class. The table indicates that Arts students are more confident (actually many of them would already know), while in the Science faculty more students perceived they would experience difficulty in gaining entry to Honours. There was no difference between males and females in either of the faculties.

(2) Ordinary:Honours

In the Science faculty only three students, all male, reported they had changed their intentions from taking an Ordinary degree to an Honours. Two of them reported that they had chosen an

Table 7:2: Final type of degree embarked on by respondents and non-respondents

		Arts				Science			
		Male		Female		Male		Female	
		S n	E n	S n	E n	S n	E n	S n	E n
Respondents	Honours	20	46	51	58	49	50	22	22
	Ordinary (three years)	1	0	13	5	1	4	4	1
	Ordinary (four years)	1	1	3	1	2	3	1	0
Non-respondents	Honours	3	24	17	32	32	15	10	9
	Ordinary (three years)	0	1	7	2	1	0	0	0
	Ordinary (four years)	0	7	1	1	3	1	0	1

Table 7:3: Students' estimates of their chances of entering an Honours class

	Science		Arts	
	Male %	Female %	Male %	Female %
Excellent	23.9	17.5	34.2	37.9
Very good	38.0	38.6	40.5	33.8
50:50	28.1	33.3	25.3	22.8
Unlikely	5.0	10.5	0.0	5.5
Poor	5.0	0.0	0.0	0.0
n =	121	57	79	145

Ordinary degree for vocational reasons, while the third had expected to be strained academically by an Honours degree. There were a variety of reasons for their change of intentions: discovering a particular interest, the standard of their first year passes or advice from an advisor of studies. They all estimated their chance of entering Honours as very good.

Among Arts students seven female students had changed their intended degree to Honours. They had chosen an Ordinary degree originally for vocational reasons (4/7)[1], expected academic problems (3/7) or did not want to spend four years on a degree (2/7). For those students who had chosen an Ordinary for vocational reasons, a change in vocational objectives was the primary reason for taking an Honours course, eg one student no longer wished to study law. Each student reported the discovery of an interest in a particular subject as a contributory factor in their choice.

(3) Honours:Ordinary

Twenty-one students had changed their intended degree from an Honours to an Ordinary, five in the Science faculty and 16 Artists.

The Science students deemed future career objectives to be the most important factors in their choice. All the females stated they were disillusioned with the academic standards, but only one, a male, reported poor performance as a contributory factor.

Each Arts student, on the other hand, admitted that poor performance was related to their change of degree. In addition, the males reported that "an ordinary offered more relevance to the real world" (2/4), and disillusionment with academic standards (3/4) were related to their change. Disillusionment also featured prominently for females.

1. It should be noted that it was possible for students to give more than one reason for their change of intention and some students did give more than one reason.

(4) Ordinary:Ordinary

Three out of four males in the Science faculty reported that career objectives were the main reason for taking an Ordinary while only one girl had always intended to take an Ordinary and did so as she expected an Honours course would be too exacting academically.

There were nine females from the Arts faculty in this group. Four wanted to be teachers while four more felt an Ordinary offered them a greater variety of courses. One student, however, mentioned the "barbaric emotional strain" of an Honours degree as contributing to her choice of degree.

7.2 CONCLUSIONS

This study has confirmed the downward trend in the proportions of students at St Andrews taking an Ordinary degree. Only eight per cent of the respondents to the survey reported they had chosen to take an Ordinary degree. Eleven per cent did take an Ordinary though, as a result of academic failure. The single group of students most likely to take an Ordinary as a result of academic failure were GCE male Arts students, and GCE students in general are more likely to take an Ordinary due to failure.

A problem with the results was the very small numbers of students who had intended or were intending to take an Ordinary. However, within the replies certain tendencies are apparent. Career objectives are a major reason for students who intend on entry to take an Ordinary, many wishing to become teachers. This is a classical Scottish route through higher education. McPherson (1973) reports that in the early 1970s 40 per cent of males and 60 per cent of females who graduated with an Ordinary degree trained as teachers. Students such as these are represented in the largest single group of students who graduated with an Ordinary in three years: the SCE qualified female Arts students.

Failure was the main reason for students who change from an Honours to an Ordinary. Disillusionment with academic standards was also prominent but it could be conjectured that the poor performance came before the disillusionment.

In summary, it is apparent that some SCE students are upkeeping the tradition of the general Ordinary while for most GCE students it is regarded as a second best option after an Honours degree.

CHAPTER 8

CONCLUSIONS

Most of the results of this thesis have been adequately discussed in the foregoing text. In this chapter we will discuss some of the implications of the research which might improve the understanding of the academic and social problems experienced by students at the University of St Andrews. In the first section we will discuss some of the methodological results, and in the second, investigate some of the educational implications of the study.

8.1 SOME METHODOLOGICAL IMPLICATIONS

8.1.1 The Need for Data

A number of the results of the preceding chapters were, perhaps, not surprising. Similar arguments had been propagated previously, but without the benefit of sound statistical backing. This study has provided a quantifiable background for such arguments. Many of the claims regarding the discrimination against Scottish students or conversely the indolence of this group (ref Chapter 1) could have been countered had the progress of students been adequately monitored.

The data discussed in Chapters 4 and 5 would have provided a sound basis for such discussions had it been available. This data has now been stored on the computer at the University of Aberdeen and is held on an SPSS file. SPSS was used for two reasons. Firstly it is comparatively easy to use compared with other statistical packages. Secondly, its facilities for producing tables and frequency distributions are also among the best. A description of this data set is contained in Appendix D.

The data contain , firstly, background information on each student: eg, their age, sex, father's occupation, secondly information on their school performance, and thirdly details of all courses taken by the students at university, together with their final degree classification or reason for leaving. A major improvement could be made by including details of the marks on which the students final grade in a course was based. Such data are readily available in the Faculty of Science, but not in the Faculty of Arts. Assessment in the Faculty of Arts is less quantified than that in the Faculty of Science, and data reflecting the marks attained by a student in each of his or her courses are not held centrally. However, collection of data on first year performance for use in the analyses of Chapter 6 revealed that data on the marks awarded to each student are held in some form by each department. In order to understand more exactly the complex routes followed to different degrees by different students, it is essential that such data are held centrally.

If data are held it follows that we must decide how accessible they should be to potential users. The SAPC report (SAPC (1975)) states that:

> "The committee recommends that there should be published the failure rate for each first year class, and a discontinuation rate for each faculty and year of study. In addition to the overall rate for all students there should also be published discontinuation rates separately for students whose sole academic qualifications are (a) SCE examinations and (b) GCE examinations".

If such figures are published, then there should be no need to restrict access to a data set such as that described above provided that steps are taken to preserve the anonymity of those students in the data set.

A problem is that unless all universities publish data pertaining to the perfo.mance of their students, or have such data accessible, then the figures of those who do publish statistics may be open to misinterpretation. For example, in Scotland, St Andrews and Edinburgh are the only universities which regularly publish data on the performance of their students. This has left St Andrews with little defence to the charge that the discontinuation rates of its SCE students are excessively high. The figures described in Chapter 2 suggest that the discontinuation rates of SCE qualified students are no higher than those elsewhere, while those for GCE qualified students are much lower than is common in other universities in the United Kingdom. One of the reasons why openness is discouraged in other universities is that it is felt that such data would lead to "league-tables" of failure rates, and misinterpretation of data. However, there can be little variability in the interpretation of carefully defined comparable statistics, and it is essential that universities permit the publication of such statistics.

A further example of the effect of the lack of comparable statistics on St Andrews is that there can be little doubt that since the initial furore and publicity surrounding the 1973/74 discontinuation rates, SCE entrants have felt that they were at a disadvantage compared with their GCE qualified contemporaries. This may also have resulted in other potentially successful students being deterred from applying. Unless data permitting the comparison of the performance of similarly qualified students on similar courses elsewhere are available, then it will be harder to convince SCE qualified students that there is no academic reason why they should experience undue difficulty with their studies. If this proved impossible, it would be even more essential that St Andrews make every effort to ensure that SCE qualified students are aware, before they choose their university, that the available evidence suggests that they should be able to successfully complete a degree course. On the other hand, if the evidence were not favourable, there is similarly no justification for properly collated data to be witheld from those to whom it is most pertinent.

8.1.2 The Use of the Data

There has been a lot of discussion of the reasons for the lack of association between school performance and university performance (Chapter 2). While we would neither expect nor hope that there would be a perfect relationship, it is hoped that this thesis has demonstrated that under careful, correct assumptions it is possible to improve the prediction of performance and to understand something of the relationships underlying the different methods by which different students attain different standards.

We shall discuss some educational implications of these analyses in Section 8.2 .

8.1.3 The Communication of Educational Research

If educational research is to have any impact on those for whom it is most relevant, it is vital that the results of such research are communicated. The results from the survey described in Chapter 6 were disseminated throughout the university by two methods[1]. Firstly,

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[1] This section was carried out jointly with Dr F C Quinault.

each member of the academic staff and student representatives received a copy of two reports (Quinault and Diamond, 1978a, 1979a), the first being distributed in October 1978 and the second in May 1979. These reports described results from the survey with a view to instigating discussion.

In conjunction with the reports, a series of meetings was held with representatives from groups of departments, the departments being divided in the groups discussed in Chapter 6. Each department was requested to send a representative but all members were invited to attend. During the year one-third of the members of staff took advantage of this invitation. At the meetings Frank Quinault and myself presented results which referred directly to the subject represented, following which there was in each case a wide, varied discussion. A further meeting was held with representatives of the students from each department.

It is through discussion that an awareness may be gained of the problems encountered by students and the discussions generated at the above meetings were very productive. It may be that the one-third of the academic staff who attended the meetings were a self-selected non-representative sample, and this is a drawback, yet it was apparent that the discussions were not among participants of one accord, and experience indicated that discussions were not confined to these meetings.

8.2 EDUCATIONAL IMPLICATIONS

We have concluded during the foregoing chapters that the differences in performance between SCE and GCE qualified students are to be expected to some extent. An obvious reason is that the GCE students are prepared for a three year degree course, and should expect that their first year should not be particularly arduous academically. More importantly, however, it has been apparent that SCE students are less well prepared than their GCE counterparts for the types of studying that they will experience at university, that they are more likely to become disheartened when things get difficult and less likely to approach one of their teachers for help, whether it be on academic or personal problems.

There are four areas in which we may attempt to implement solutions to the differences between SCE and GCE qualified students: at the school, in selection for university, at the university, or in a combination of the above three. Let us consider the schools first.

It would be easy to criticize Scottish schools for teaching in too authoritarian a way, thus leaving their students ill-prepared for study at university. However, as was stated in Chapter 3, not all those taking Highers will progress to university and the responsibility of the teacher must be to ensure that his students perform as well as possible within the system. The Highers system requires that the students sit approximately five subjects after one year of study. A simple solution to reduce the level of "exam pressure" surrounding the Highers course would be to extend the length of time for which the students studied for their Highers. This could be achieved in three ways. Firstly, by able students taking their 'O' grade after three years of secondary education or by electing not to take an 'O' grade in a subject to be studied at Higher. A criticism of such an approach is that it would require the students choosing their Highers courses very early in their school career. Secondly, the date of the Higher examination could be put back by, for example, one month. This has been dismissed by the SCEEB who argue that the universities need the results quickly. Such views are questionable as the universities receive GCE results at a later date. Thirdly, the most radical suggestion would be to lengthen Highers courses to last two years. Such an approach could be argued to negate the need for four year university courses, and as such would not be accepted by the universities. However, as a majority of SCE qualified entrants have experienced a sixth year, a two year Higher course would merely formalise this situation.

If this last option is rejected, then we must consider the best way of constructing the sixth year. At present the CSYS is under criticism as being without a purpose, and the sixth year is being increasingly used to "upgrade" or to take new Highers. If the CSYS is to remain in anything like its present form then it must be decided whether it should "lead the pupil into habits of positive and rewarding private study, should promote individual thinking and judgement and should develop self reliance and responsibility in place of his present almost absolute dependence on his teachers" (SED 1960) and not be used as a prerequisite for university entry, or whether it should be considered as a university foundation. If the former is chosen, then it will be necessary to make efforts to present the course as worthwhile to the students, and also to counter the present tendency for those who are offered an unconditional place at university in the February of their sixth year to relax their efforts and, in many cases, not sit the examination. Perhaps this latter problem could be overcome by making the university place conditional on a "satisfactory" completion of the sixth year. The term "satisfactory" could be flexible and include, for example, intending language students spending time abroad.

If the sixth year were to be used as a university foundation year, then again the four year Scottish degree would be threatened which would be unacceptable to the universities and would require that those students not going to university take a course oriented towards university entry which would be unacceptable to the schools. Therefore the former course is to be preferred.

Next, let us consider how changes in the selection procedure might improve the prospects of SCE entrants. We observed in Chapter 4 that those students whose best four Highers were four 'C' grades were now unlikely to be admitted. For all combinations of Higher grades above this students failed but a number passed. We concluded that raising the entrance qualifications would serve not only to exclude likely failures but also to exclude some students who would perform well. Therefore, there appears to be little improvement that can be made directly in terms of admissions. Instead, efforts should be concentrated on minimising the changes experienced by students on their transition from school to university. We shall consider this now as the third of our areas: interaction between school and university.

In order that the transition between school and university (see Section 6.2) is as smooth as possible, it is essential that there is communication between the schools and the university. Such occasions as pre-university schools and "open-days" should become the norm rather than the exception, as should instruction on such things as study habits and general university orientation. A "pupil" should commence the transition to "student" before entering the university and should be helped to feel part of the "academic community" as soon as possible.

Finally, there is surely a case for some kind of limited interaction between lecturers and school-teachers with lecturers going into schools and teachers into universities. This could only help the understanding between both sectors of education.

Let us now consider the implications for the university.

Firstly, it is apparent that an adequate available counselling service is essential. Furthermore, going to see a counsellor should not be considered a symptom of failure and thus to be avoided until all alternatives have been exhausted. Secondly, there is a need for adequate advice over the subjects to be taken by the student in their first year. For example, we have seen that, in Science subjects, those students whose grade in the corresponding Higher was a 'C' are likely to experience great difficulty with the course at university. These students should perhaps be advised that they may be more likely to succeed on an alternative course.

Although the students tended not to report a gap in the knowledge they acquired at school and that which was assumed by their university courses, it would be advisable for university lecturers to be aware of the approaches to different topics at school so as to appreciate the level of knowledge attained by the "average" school student. Finally, there is, perhaps, a need for greater student-lecturer contact especially in the Science faculty where we observed that very few SCE qualified students felt able to approach their lecturers for assistance. An increased use of tutorials in the Science faculty might help students to feel easier about consulting their lecturers.

8.3 SUMMARY

This chapter may best be summarised as a call for two things to help students to overcome the difficulties they will face at university. These are awareness and availability. Awareness of the problems and environment facing new students and availability of staff to help them to overcome them. As Wesker (1960) wrote: "Education

isn't only books and music - it's asking questions all the time".
All students should feel able to ask these questions.

APPENDIX I

BIBLIOGRAPHY

ABERCROMBIE, M.L.J., HUNT, S., STRINGER, P. 1969. Selection and Academic Performance of Architecture Students, SRHE, London.

AHMANN J.S., SMITH, W.L. and GLOCK, M.D. 1958. Predicting Academic Success in College by Means of a Study Habits and Attitude Inventory. *Educ. and Psych. Meas.* 18, pp.853-857.

ANGOFF, W.H. (Ed). 1971. The College Board Admissions Testing Program : A Technical report on research and development activities relating to the Scholastic Aptitude Test and Achievement Test. N.Y. College Entrance Examinations Board.

ARKIN, R.M. and MARUYAMA, G.M. 1979. Attribution, Affect and College Examination Performance. *Journal of Educational Psychology.* 71, pp.85-93.

ASHTON, W. 1972. The Logit Transformation. Griffin, London.

ASTIN, A.W. 1971. Predicting Academic Performance in College. New York Free Press.

ASTIN, A.W. 1973. Student Persistence : some stay, some don't - why? *College and University.* 48, pp.298-306.

ASTIN, A.W. 1975. Preventing Students from Dropping Out. San Francisco, Josey-Bass.

ASTIN, A.W. 1977. Four Critical Years. Josey-Bass, London.

AUSTWICK, K. 1960. G.C.E. to B.A. *Univ. Quart.* 15, pp.64-71.

BAGG, D.G. 1968. The Correlation of G.C.E. 'A' level grades with University examinations in chemical engineering. *British J. Educational Psychology.* 38, pp.194-197.

BAGG, D.G. 1970. 'A' levels and University Performance. *Nature.* 225, 21 March, pp.1105-08.

BAKER, R.J. and NELDER, J.A. 1978. The GLIM System Release 3. RSS. Oxford.

BANRETI-FUCHS, K.M. and MEADOWS, W.M. 1976. Interest, Mental Health and Attitudinal Correlates of Academic Achievement among University Students. *Brit. J. Ed. Psych.* 46, pp.212-218.

BARNETT, V.D. and LEWIS, T. 1963. Study of the relation between GCE and degree results. *J.R.S.S.* 'A', 126, pp.187-226.

BARNETT, V.D. HOLDER, R.L. and LEWIS, T. 1968. Some new results on the association between students' ages and their degree results. *J.R.S.S.* 'A', 131, pp.410-423.

BARRETT, E.M. 1977. First Year University Performance of Mature Unmatriculated Students. *Ednal Res. and Perspectives.* 4, No.1., pp.15-22.

BARTHOLOMEW, D.J. 1975. Stochastic Models for Social Processes. J. Wiley and Sons, London.

BASSEY, M. 1975. The Random Factor in Student Achievement. *Higher Education Review.* 7, pp.53-59.

BAUMGART, N.L. and JOHNSTONE, J.N. 1977. Attrition at an Australian University - A Case Study. *J. Higher Ed.* 48, (5), pp.553-70.

BAYER, A.E. 1968. The College Dropout: Factors affecting senior college completion. *Sociology of Education.* 41, pp. 305-316.

BAYER, A.E. et al 1973. Four Years After College, ACE Research Report 8, Washington D.C.

BEAUSANG, S. 1977. Discussion Document No. 2. - The Points System - The Alternatives. NCGS Cork, Univ. of Cork, Ireland.

BEAUSANG, S. 1976. Discussion Document No.1. - The Points System. Cork NGGS, Univ. of Cork, Ireland.

BERKSON, J. 1951. Why I Prefer Logits to Probits. *Biometrics.* 7,pp327-339

BIGGS, J. 1970. Personality Correlates of Certain Dimensions of Study Behaviour. *Australian Jnl. of Psychology.* 22, pp 161-174.

BLANCHFIELD, W.C. 1971. College dropout Identification : A Case Study. *Journal of Experimental Education.* 40, pp.1-4.

BLAUG, M. 1971. An Introduction to the Economics of Education. Harmondsworth, Penguin.

BOUD, D. 1979. Engineering Success : The Progress and Problems of Higher Education Developing Project. Studs. in Higher Education. 4, No.1, pp.55-66.

BRAGG, E.W. 1956. A Study of Student withdrawal at "W.U.". *Journal of Educational Psychology*. 47, pp.199-202.

BROWN, W.F. and HOLTZMAN, W.H. 1955. A Study - Attitudes Questionnaire for Predicting Academic Success. *J. Educ. Psychology*. 47, pp.75-84.

BROWN, W.F. and HOLTZMAN, W.H. 1966. Manual of the Survey of Study Habits and Attitudes. New York, The Psychological Corporation.

CARMICHAEL P.W. & SNEATH P.H. 1969. Taxometric Maps. *Syst. Zool.* 18, pp.402-415.

CHASE, C.I. 1970. The College Dropout - His High School Prologue. *Bulletin of the National Association of Secondary School Principals*. 54, pp.66-71.

CHOPPIN, B.H.L. and ORR, L. 1973. The Prediction of Academic Success. Slough, NFER.

COHEN, L. and CHILD, D. 1969. Some Sociological and Psychological factors in University Failure. *Durham Research Review*. 22, pp.365-372.

COLLINGWOOD, V. and HUGHES, D.C. 1978. Effects of Three Types of University Lecture Notes on Student Achievement. *J. Ed. Psych.* 70, pt.2., pp.175-179.

COOPER, B. and FOY, J.M. 1969 Students' Study Habits, Attitudes and Academic Attainment. *Univ. Quart.* 23, pp.203-212.

COPAS, J.B. and WHITELEY, J.S. 1976. Predicting Success in the Treatment of Psychopaths. *British Journal of Psychiatry*. 129, pp.388-392.

COPE, R.G. 1968. Limitations of attrition rates and causes given for dropping out of College. *Journal of Coll. Stud. Personnel.* 9, pp.386-392.

COPE, R. and HANNAH, W. 1976. Revolving College Doors. Wiley, New York.

CORMACK, R.M. 1971. A Review of Classification. *J.R.S.S. 'A'.* 134,part 3, pp. 321-367.

COWELL, M.D. and ENTWISTLE, N.J. 1971. Personality, Study Attitudes and Academic Performance in a Technical College. *British Journal of Educational Psychology.* 41, pp.88-95.

COX, D.R. 1970. The Analysis of Binary Data. London, Methuen.

COX, R. 1967. Examinations and Higher Education. *Univ. Quart.* 21, pp.292-240.

CRAIG, G.W. and DUFF, P.McH.D. 1961. Academic Success and Failure Among Pure Science Students 1954-1959. *Univ. of Edinburgh Gazette.* May, 18-23.

CRAIN, R.L. and MAHARD, R.E. 1978. School Racial Composition and Black College Attendance and Achievement Test Performance. *Soc. of Edn.* 51, pp.81-101.

CRONBACH, L.J. 1949. Essentials of Psychological Testing. Harper & Bros., NY.

DALE, R.R. 1954. From School to University. London, Routledge and Keegan Paul.

DALE, R.R. 1963. Reflections on the influence of social class on student performance at university. *Sociol. Rev. Monograph.* 7, pp. 131-140. Keele,University of Keele.

DALE, R.R. and MILLER, P.McM. 1972. The Academic Progress of University Students from Co-educated and Single Sex Schools. *B. J. Ed. Psych.* 42, pp.317-319.

DAVY, B.W. 1960. The Source and Prevention of Mental Ill Health in University Studies. Proceedings of the Royal Society of Medicine.

DELCOIGNE, A. and HANSEN, P. 1975 Sequence Comparison by Dynamic Programming. *Biometrika.* 62. pp. 661-664.

DEMITROFF, J.F. 1974. Student Persistence. *College and University.* 49, pp.553-567.

DOBSON, C.B. 1979. Study Inventory Responses and 'A' Level Grades. *Educational Studies.* 5, No.2., pp.127-134.

DOUVAN, E. and KAYE, C. 1964. Why People Go to College : Motivational Factors. in N.Sanford (Ed) College and Character, NY, Wiley.

DUNCAN, A.S. and VANDOME, P. 1971. Report of the Student Academic Performance Committee, 1967-1970. University of Edinburgh.

ENTWISTLE, N.J. and BRENNAN, T. 1971. The Academic Performance of Students 2. Types of Successful Students. *British Journal of Educational Psychology.* 41, pp.268-271.

ENTWISTLE, N.J. and ENTWISTLE, D.M. 1970. The Relationship between Personality, Study Methods and Academic Performance. *British Journal of Educational Psychology.* 40, pp.132-141.

ENTWISTLE, N.J., NISBET, J., ENTWISTLE, D. and COWELL, M.D. 1971. The Academic Performance of Students 1. Prediction from Scales of Motivation and Study. *British Journal of Educational Psychology.* 41, pp.258-267.

ENTWISTLE, N.J., PERCY, K.A. and NISBET, J.B. 1971. Educational Objectives and Academic Performance in Higher Education. *Mimeographed Report.* University of Lancaster, Department of Educational Research.

ENTWISTLE, N.J. and PERCY, K.A. 1974. Critical thinking or conformity? An Investigation of the aims and outcomes of higher education. In *SRHE*, Research into Higher Education. 1973, London, SRHE.

ENTWISTLE, N.J., THOMPSON, J.B. and WILSON, J.D. 1974. Motivation and Study Habits. *Higher Education.* 3, pp.379-396.

ENTWISTLE, N.J. and WILSON, J.D. 1977. Degrees of Excellence. London, Hodder and Stoughton.

EYSENCK, H.J. 1947. Student selection by means of psychological tests - a critical survey. *British Journal of Educational Psychology*. 17, pp.20-39.

EYSENCK, H.J. 1957. The Dynamics of Anxiety and Hysteria. London, Routledge and Kegan Paul.

EYSENCK, H.J. 1965. Fact and Fiction in Psychology. Harmondsworth, Penguin.

EYSENCK, H.J. 1970. The Structure of Human Personality. London, Routledge and Kegan Paul.

EYSENCK, H.J. 1972. Personality and Attainment : An application of psychological principles to educational objectives. *Higher Education*. 1, pp.39-52.

FARRELL, J.L. 1977 Study Habits and Ac.Ach Pt. II - An Investigation into the relationship between study habits and 'A' level achievement. *Bulletin of Ed. Res.* 14, pp.28-36.

FLECKER, R. 1959. Characteristics of Passing and Failing Students in First Year University Mathematics. *The Educand*. Univ. of West. Aust., Press 3, pt.3.

FLEMING, W. 1962. Personal and Academic Factors as Predictors of 1st Year Success in Ontario Universities. Dept. of Educational Research, Ontario Coll. of Ed., University of Toronto.

FLYNN, R. 1976. Home Based Residence in Higher Education. *Higher Education Review*. 8, No5., pp.47-57.

FORSTER, M. 1959. An Audit of Academic Performance. Belfast, Queens University.

FRANK, A.C. and KIRK, B.A. 1975. Differences in Outcomes for Users and Non-users of University Counselling and Psychiatric Services. *Journal of Counselling Psychology*. 22, pp.252-258.

FREEMAN, P.R. 1970. A Multivariate Study of Students' Performance in University Examinations. *J.R.S.S. 'A'*. 133, part 1, pp. 38-55.

FULLMER, D.W. 1956. Success and Perseverance of University Students. *Journal of Higher Education.* 27, pp.445-447.

FURNEAUX, W.D. 1961. The Chosen Few. Oxford, University Press.

FURNEAUX W.D. 1962. The Psychologist and the University. *Universities Quarterly.* 17, pp 33-47.

GANI, J. 1963. Formulae for Projecting Enrolments and Degrees Awarded in Universities. *J.R.S.S.* 'A', 126, pp.400-409.

GALTUNG, J. 1966. International Relations and International Conflicts : a Sociological Approach. Transactions of the 6th World Congress of Sociology, 1., pp.121-161.

GILL, J. 1971. A Short Study of the Relation between Examination Entrance Qualifications and University Performance at the University of St. Andrews. M.Sc. Thesis, University of Sussex.

GILROY, I. 1979. Comment to CSYS Discussion group in QUINAULT, F.C. "Report of the Working Conference on the Transition from Secondary to Tertiary Education. University of St. Andrews, Department of Psychology.

GORDON, A.D. 1973. A Sequence-Comparison Statistic and Algorithm. *Biometrika.* 60, pp.197-201.

GORDON, A.D. 1979. A measure of the agreement between rankings. *Biometrika.* 66, pp.7-15.

GORDON, A.D. and REYMENT, R. 1979. Slotting of Borehole Sequences. *Journal of Mathematical Geology.* 11,part 3, pp. 309-327.

GOULD, E.M. and McCOMISKY, J.G. 1958. Attainment Level on Leaving Certificate and Academic Performance at University. *British Journal of Educational Psychology.* 28,pp.129-134.

GRAY, G.A. and SHORT, L.N. 1961. Student Progress in the University (1958-1960) (Mimeo). University of New South Wales, 1961.

GRAY, J. and SATTERLY, D. 1976. A chapter of errors : Teaching Styles and Pupil Progress in retrospect. *Educational Research.* 19, pp.45-56.

GREENFIELD, J.W.D. 1979. Correlates of Examination Performance in First Year Biology. Univ. of Dundee. Dept of Biology.

GREINER, R. 1909. Uber das Fehlersystem der Kollektiumasslehre Zeitschrift fur Mathematik und physik. 57.

GOULD, E.M. and McCOMISKY, J.G. 1958. Attainment level on leaving certificate and academic performance at university. *British Journal of Educational Psychology*. 28, pp.129-134.

HARRIS, D. 1940. Factors Affecting College Grades : A Review of the Literature. *Psychology Bulletin*. 37.

HEIM, A.N. and WATTS, K.P. 1960. An Enquiry into the Relationship between University Career and Scores on a High Grade Intelligence Test. *Cambridge Review*. 8, pp.463-469.

HENDRY, L.B. and DOUGLASS, L. 1975. University Students : Attainment and Sport. *British Journal of Educational Psychology*. 45, pp.299-306.

HIMMELWEIT, H.T. 1950. Student Selection : an experimental investigation. *British J. Sociology*. 1, pp.50-71.

HIMMELWEIT, H.T. 1963. Student Selection - implications derived from two student selection enquiries. *Sociological Review Monograph*. 7, pp.79-98.

HOARE, D.E. 1973. Performance of Sixth Year Studies Students (Chemistry) at University Dept. of Chemistry, University of Dundee.

HOARE, D.E. and YEAMAN, E.J. 1971. Patterns of Teaching and Learning of First Year Chemistry in Scottish Universities. *Scot. Ed. Studies*. 3, No.2., pp.79-87.

HODSON, F.R., KENDALL, D.G. and TAUTU, P. 1971. Mathematics in the Archaeological and Historical Sciences. Edin. Univ. Press.

HOHNE, H.H. 1951. The Prediction of Academic Success, Report No. 1. on the Faculty of Arts in the University of Melbourne. Australian Council for Educ. Research. Melb.

HOPKINS, J., MALLESON, N. and SARNOFF, I. 1958. Some non-intellectual correlates of success and failure among university students. *British Journal of Educational Psychology.* 28, pp.25-36.

HORST, P. 1957. Differential Prediction in College Admissions. *College Board Review.* 33, pp.19-23.

HOUSTON, J.G. 1975. Scottish CSYS Physics Students at Universities outside Scotland. *Scot.Ed. Studs.* 7, pp.23-27.

HOWELL, D.A. 1962. A Study of the 1955 entry to British Universities. (Evidence to Robbins Committee on Higher Education HMSO 1964) Mimeo.

HUDSON, L. 1968. Frames of Mind. London, Methuen.

HUMPHREYS, L.G. 1968. The fleeting nature of the predictions of college academic success. *J. Educ. Psych.* 59, pp.375-380.

HUTCHINSON, B. 1958. Structural and exchange mobility in the assimilation of immigrants of Brazil. *Popn. Studies.* 8, pp.111-120.

IFFERT, K.E. 1958. Retention and withdrawal of college students. *U.S. Dept of Health, Education and Welfare, Bulletin No. 1.* Washington DC U.S. Govt., Printing Office.

INGENKAMP, K. 1977. Educational Assessment, Slough , NFER.

IRONSIDE, J. 1966. Student Mental Health. Wellington, Bulletin of New Zealand Council for Educational Research.

JARDINE, N. and SIBSON, R. 1971. Mathematical Taxonomy. New York, Wiley.

JOHANSSON, C.B. and ROSSMANN, J.E. 1973. Persistence at a Liberal Arts College : A replicated five year longitudinal study. *J. Counselling Psychology.* 20, pp.1-9.

JOHNSTONE, A.H. and SHARP, D.W.A. 1979. Some innovations in University Chemistry Teaching. *Studies in Higher Edn.* 4, No.1., pp.47-54.

JOLLY, W.P. and TURNER, C.W. 1979. The Transition from School to university some experimental inductions progs. for Engineering students. *Studies in Higher Education.* 4, No.1., pp.39-46.

JONES, C.L. 1972. Paths to Honours. Mimeographed Paper. Centre for Educational Sociology, University of Edinburgh.

JONES, C.L., MACKINTOSH, H. and McPHERSON, A.F. 1973 a. The Association between various measures of SCE performance, academic achievement and wastage in the first year at Edinburgh University in 1969-70. Centre for Educational Sociology, University of Edinburgh.

JONES, C.L., MACKINTOSH, H. and McPHERSON, A.F. 1973 b. Residence and First Year. *Universities Quarterly*. 28, part 1, pp. 101 - 122.

JONES, C.L. and McPHERSON, A.F. 1971. Varieties of Consumer Demand for Scottish Tertiary Education. Centre for Educational Sociology. Univ. of Edinburgh.

KAMENS, D.H. 1971. The College "Charter" and College Size : Effects on Occupational Choice and College Atritition. *Sociology of Education*. 44, pp.270-296.

KAPUR, R.L. 1972. Student Wastage at Edinburgh University II. *Univ. Quart.* 26, pp.487-496.

KAPUR, R.L. 1971.. Student Wastage at Edinburgh University I. *Univ. Quart.* 26, p.353.

KELLY, A. 1977. The Comparability of Examining Standards in Scottish Certificate of Education Ordinary and Higher Grade Examinations. S.C.E.E.B. Dalkeith.

KELLY, A. 1978. Sex Differences in Science Enrolments : Reasons and remedies. *Collaborative Research Newsletter*. 4, pp.61-68.

KELSALL, R. 1963. University Student selection in relation to subsequent academic performance : a critical appraisal of the British evidence. *Sociological Review Monograph*. 7, pp.99-115.

KELVIN, R.P., LUCAS, C.J. and OJHA, A.B. 1965. The Relation between personality, mental health and academic perfomance in University students. *British J. social and clinical Psychology*. 4, pp.244-253.

KENDALL, M. 1964a. Those who failed - I : the further education of former studen: *Universities Quarterly*. 18, pp.398-406.

KENDALL, M. 1964b. Those who failed II : the further education of former students. *Univ. Quart.* 19.

KIDD, C.B. and CALDBECK-MEENAN, J. 1960. A Comparative Study of Psychiatric Morbidity Among Students at 2 different Universities. *British J. Psychiatry.* 112, pp.57-64.

KLINE, P. and GALE, A. 1971. Extraversion, Neuroticism and Performance in a Psychology examination. *B.J. Ed. Psych.* 41, pp.90-93.

KLINGENDER, F.D. 1955. Student Recruitment in England. *Universities Quarterly.* 9, pp.168-176.

KNOELL, P.M. 1966. A Critical Review of Research on the College Dropout. in Perwin, L.A., Reik, L.E. and Dalrymple, W. (Eds). The College Dropout and the utilisation of talent. Princeton, Princeton University Press.

LANCE , G.N. and WILLIAMS, W.T. 1966. Computer Programs for Hierarchical Polythetic Classification. *Computer Journal.* 9, pp. 60-64.

LAVIN, D.A. 1965. The Prediction of Academic Performance. NY, Wiley.

LEWIS, T.B. 1970. The Statistician as a member of society. University of Hull.

LUCAS, C.J., KELVIN, R.P. and OJHA, A.B. 1966. Mental Health and Student Wastage. *British Journal of Psychiatry.* 112, p.484.

LUM, M.K.M. 1960. A Comparison of Under and Over achieving Female College Students. *Journal of Educ. Psych.* 51, pp.109-114.

LYNN, R. and GORDON, I.E. 1961. The relation of neuroticism and extraversion to educational attainment. *British J. of Educ. Psych.* 31, pp.194-203.

McCRACKEN, D. 1969. University Student Performance. Report of the Student Health Department, University of Leeds.

MACKLIN, A.D. 1951. Proceedings of Home University Conference.

MACLAINE, A.G. 1965. A programme for improving teaching and learning in Australian Universities. *The Australian University*. 3.

McLELLAND, D.C. et al. 1953. The Achievement Motive. New York, Appleton-Century-Crofts.

McPHERSON, A.F. 1973. Nobody wants an Ordinary. Times Educational Supplement, Scotland.

McPHERSON, A.F. 1975. National Differences in Pedagogy and First Year Achievement at Edinburgh University. *Scot. Educ. Studies.* 9, No.2., pp.49-66.

McPHERSON, A.F. and NEAVE, G. 1976. The Scottish Sixth NFER, Slough.

McPHERSON, A.F. and NEAVE, G. 1976. Innovation and the Organisation of Educational Knowledge. *Higher Education Review.* 8, No.3., pp.41-53.

McPHERSON, A.F. 1979. Comment to Seminar by I. Diamond, Centre for Educational Psychology, University of Edinburgh : May 23, 1979.

McIVEY, P.J. 1977. A Comparison of Reliability : Objective and Conventional Examinations in Electrical Engineering. *Int. J. of El. Eng. Edn.* 15 , pp.109-114.

MALLESON, N.B. 1958. Student Performance at University College, London. *Universities Quarterly.* May, U.C. London.

MALLESON, N.B. 1959. University Student 1953 I - Profile. *Universities Quarterly.* 13, pp.287-298.

MALLESON, N.B. 1960. University Students 1953 : IV, Different sorts of students. *Universities Quarterly.* 15, pp. 54-63.

MALLESON, N.B. 1963. The influence of emotional factors in University education. *Sociological Review Monograph.* 7, pp.141-159.

MARKS, E. 1967. Student Perceptions of College Persistence and their Intellective, Personality and Performance Correlates. *J. of Educ. Psyc.* 58, pp.210-2?1.

MARRIS, P. 1964. The Experience of Higher Education. London, Routledge and Kegan Paul.

MARSH, L.M. 1966. College Dro pout : A Review. *Personnel and Guidance Journal*. 44, pp.475-81.

MAXWELL, A.E. 1977. Multivariate Analysis in Behavioural Research. London, Chapman and Hall.

MEHRABIAN, A. 1968. Male and female scales of the tendency to achieve. *Educational and Psychological Measurement*. 28, pp.493-502.

MILLER, G.W. 1970. Success, Failure and Wastage in Higher Education. London, Harrap.

MILLER, G.W. 1970. Higher Education Research in Australia and New Zealand. SRHE. London.

MILLER, P. McM and DALE, R.R. 1974. A Comparison of the Degree Results of University students from Co Educational and Single Sex Schools. *B.J.Ed. Psych*. 44, pp.307-308.

MOODIE, G.C. 1959. The Universities : A Royal Commission? Fabian Society, London.

MORRISEY, R.J. 1971. Attrition in Probationary Freshmen. *Journal of College Student Personnel*. 12, pp.279-285.

MOSTELLER, F. and TUKEY, J.W. 1977. Data Analysis and Regression. New York, Wiley.

MULLINGER, C. 1979. The Scotsman, 13 August 1979.

MURPHY, R.J.L. 1978. Reliability of Marking in Eight GCE Examinations. *British J. Educational Psychology*. 48, pp.196-200.

MURRAY Committee. 1957. Report of the Committee on Australian Universities Canberra.

McNEELY, J.J. 1938. College Student Mortality. Washington D.C. U.S. Off. of Ed. Bulletin, 1937, No. 11.

NELSON-JONES, R. and TONER, H.L. 1977. A Study of First Year University of Aston Students as learners. Birmingham, Aston University, Dept of Educational Enquiry.

NELSON-JONES, R. and TONER, H.L. 1978. Counselling Approaches to Increasing Students' learning competence. *B.J. Guidance and Counselling.* 6, pt.1., pp.19-34.

NEWCOMB, T.M. 1962. Student Peer-group Influence. in N. Sanford (ed) The American College. NY, Wiley.

NEWFIELD, J.G.Y. 1963. Some Factors Related to the Academic Performance of British University Students. in P. Halmos (ed). *The Sociological Review Monograph.* No. 7., Keele, Univ. of Keele.

NICHOLSON, J. and GALAMBOS, R. 1960. The Association between GCE Advanced Level Performance and Achievement at the University of Hull. Hull, University of Hull.

NIE, N.H., HULL, C.H., JENKINS, J.G., STEINBRENNER, J. and BENT, D.H. 1975. S.P.S.S. Second Edition.. New York, McGraw Hill.

NISBET,J.D. 1974. Adding and Averaging Grades. *Ednal. Research.* 17.

NISBET, J.D. and WELSH, J. 1966. Predicting Student Performance. *Univ. Quart.* 20. pp. 468-481.

NISBET, J.D. and WELSH, J. 1973. Diagnosing First Year Failure. *Universities Quarterly,* 27, pp. 457-464.

NISBET, J.D. and WELSH, J. 1976. Prediction of Failure at University - or Failure of prediction? *B.J. Ed. Psych.* 46, pp.261-266.

NISBET, S.D. and NAPIER, B.L. 1969. Promise and Progress : University of Glasgow Student Survey 1962-1968. First Report, Department of Education, University of Glasgow.

NUTTALL, D.L., BACKHOUSE, J.K. and WILLMOTT, A.S. 1974. Comparability of standards between subjects. London, Evans.

O.E.C.D. 1971. Development of Higher Education 1950-1967. Analytical Report. Paris, O.E.C.D.

OLSEN, F.J. 1957. Failure in First Year University Examinations. *Australian Jnl. of Education.* 1, part 3.

ORR, L. 1974. A Year Between School and University. Slough, NFER.

PANATAGES, T.J. and CREEDON, C.F. 1978. Studies of College Attrition 1950-1975. *Review of Ednal Research.* 48, No.1., pp.49-102.

PANOS, R.J. and ASTIN, A.W. 1968. Attrition among College Students. *American Education Res. J.* 5, pp.57-72.

PARLETT, C. 1970. The Syllabus Bound Student. in Hudson, L. The Ecology of Human Intelligence. Harmondsworth. Penguin.

PARKYN, G.W. 1959. Success and Failure in University - I Academic Performance and the Entrance Standard. Wellington, New Zealand Council for Educational Research.

PARKYN, G.W. 1967. Success and Failure in University - II The Problem of Failure. Wellington, New Zealand Council for Educational Research.

PERVIN, L.A., REIK, L.E. and DALRYMPLE, W. (Eds) 1966. The College dropout and the utilisation of talent. Princeton, Princeton University Press.

PETERS, R.S. 1958. The Concept of Motivation. London, Routledge.

PARNELL, R.W. 1951. Morbidity and Prolonged Illness Among Oxford Undergraduates. *Lancet.* 1, pp.731-33.

PENG, S.S., ASHBURN, E.A. and DUNTEMAN, G.H. Withdrawal from Institutions of Higher Education : An Appraisal with Longitudinal Data Involving Divers Institutions. (NCES 77-264) Wash. DC. U.S. Govt Printing Office. 1977.

PENG, S.S. and FETTERS, W.B. Variables involved in withdrawal during the first two years in college : Preliminary findings from the National Longitudinal study of High School Class of 1972. *Am. Ed. Res. J.* 15, pt.3., 1978, pp.361-372.

PETCH, J.A. 1961. GCE and Degree - I. Manchester. NUJMB.

PETCH, J.A. 1963. GCE and Degree-II. Manchester, NUJMB.

PIKE, D.J. and GARDNER, J. 1975. Neighbourhood Universities - An investigation into their reality and feasibility. University of Reading.

PIKE, R.M. 1970. Who doesn't get to university - and why: a study of accessibility to higher education in Canada. Ottawa,Association of Universities and Colleges of Education.

PILLINER, A.E.G. 1960. Prediction of success in the arts faculty of the University of Edinburgh by marks obtained at the Scottish Leaving Certificate examination. Unpublished report, University of Edinburgh, Dept. of Education.

PILKINGTON, G.W. and HARRISON, G.J. 1967. The relative value of two high level intelligence tests, advanced level and first year university marks for predicting degree classification. *British J. Educ. Psych.* 37, pp.382-389.

POND, L. A Study of High Achieving and Low Achieving Freshmen. *Australian Journal of Higher Education.* 2, part 1. 1964.

POWELL, J.L. 1973. Selection for University in Scotland. Edinburgh, SCRE.

QUINAULT, F.C. and DIAMOND, I.D. 1978a. The Bejant's Progress I. University of St. Andrews.

QUINAULT, F.C. and DIAMOND, I.D. 1979a. The Bejant's Progress II. University of St. Andrews.

QUINAULT, F.C. and DIAMOND, I.D. 1979b. Beyond Highers : The Transition from School to a Scottish University. *Collaborative Research Newsletter.* No.6., University of Edinburgh.

ROBB, R.A. 1956. An Analysis of Students in the Faculty of Science in Relation to Educational Qualifications. Unpublished Report, University of Glasgow.

ROBINSON, L.F. 1967. Relation of Student persistence in College to satisfact with "environmental factors". (Ph.D. University of Illinois) University Microfilms No.67-12, 154.

ROSS, A. and MONTGOMERY, J. 1961. The Performance of Students in the Arts Faculty at Edinburgh University. *University of Edinburgh Gazette*

ROBBINS REPORT. 1963. Higher Education (Cmnd 2154). London, HMSO.

ROYAL COMM OF UNIV. OF WEST. AUSTRALIA. 1942. Report. Government Printer

S.A.R.A. 1979. Failure Rates at St. Andrews - Press Release. St. Andrews Radical Alliance.

ST. ANDREWS S.A.P.C. 1975. Student Academic Performance 1972-1975. University of St. Andrews.

SANDERS, C. 1961. Psychological and Educational Bases of Academic Performance. Brisbane, Australian Council for Educational Research.

SAVAGE, R.D. 1962. Personality Factors and academic Performance. *British J. Educ. Psych.* 32, pp.251-3.

S.C.R.E. 1936. The Prognostic Value of University Entrance Examinations in Scotland. London, University of London Press.

SCANNEL, D.D. 1960. Prediction of College Success from Elementary School Performance. *Journal of Educational Psychology.* 51, pp.130-134.

SCHMITHOFF, M. 1939. The Science of Comparative Law. *Cambridge Law Journal.* 7.

SCHONELL, F.J., ROE, E. and MEDDLETON, I.G. 1962. Promise and Performance : A Study of Student Progress at University Level. Brisbane, University of Queensland Press.

S.E.D. 1960. Report of the Advisory Council on Education in Scotland : the Post Fourth Year Examination Structure in Scotland. Edinburgh, HMSO.

S.E.D. 1966. Circular Letter No.2.

SEWELL, W.H. and SHAH, V.P. 1967. Socioeconomic Status, Intelligence and the Attainment of Higher Education. *Sociology of Education.* 40, pp.1-2

SIBSON, R. 1971. Some Thoughts on Sequencing Methods in Hodson, F.R., Kendall, D.G. and Tautu, P. (Eds)

SLOCUM, W.L. 1956. Social Factors involved in Academic Mortality. *College and University.* 32, pp.53-64.

SMALL, J.J. 1966. Achievement and Adjustment in the First Year at University. Wellington, New Zealand Council for Educational Research.

SMITH, M. 1978. Teaching to Learn? *Studies in Higher Education.* 3, p.221.

SMITHERS, A.G. 1973. Factors in the Success and Failure of Students, in Flood Page, C. and Gilson, J. (ed) Motivation : Non-Cognitive Aspects of Student Performance. SRHE, London.

SMITHERS, A.G. and BATCOCK, A. 1970. Success and Failure among Social Scientists and Health Scientists at a Technological University. *Brit. J. Ed. Psych.* 40, pp.140-153.

SMITHERS, A.G. and DANN, S. 1974. Success and Failure Among Engineers, Physical Scientists and Linguists at a Technological University. *Brit. J. Ed. Psych.* 44, pp.241-247.

SONQUIST, J. and MORGAN, J. 1963 Problems in the Analysis of Survey Data, and a Proposal. *J. Am. Stat. Ass.* 58, pp.415-35.

SPADY, W.G. 1970. Dropouts from Higher Education : An inter-disciplinary Review and Synthesis. *Interchange.* 1, pp.70-85.

SPADY, W.G. 1971. Status, Achievement and Motivation in the American High School. *School Review.* 79, pp.79-403.

STARTUP, R. 1972. Why go to University? *Univ. Quart.* 72, pp.317-331.

STILL, R.J. 1966. Psychological Illness among Students in the Examination Period (Mimeo). Department of Student Health, University of Leeds.

SUMMERSKILL, J. 1962. Dropouts from College in N. Sanford (ed) The American College. NY, Wiley.

SUTTON, R.A. 1977. The Interface between School and University. *Physics Education.* 12, pp.304-310.

TAYLOR, S.B. 1979. Contribution to Conference on Transition from Secondary to Tertiary Education. Dundee Coll. of Education, July 1979.

THODAY, D. 1957. How Undergraduates Work. *Univ. Quart.* 11, pp.172-181.

THOMPSON, J.B. 1976. An interview study of the motivations and personality characteristics of 124 students in higher education. Ph.D., University of Lancaster.

THOMSON, J.S. 1974. Performance of First Year University Physics Students in a Mathematics Questionnaire. *Scot. Ed. Studs.* 6, pp.87-89.

TRAPP, R.P., PHILLIPS, A.V., and STACEY, G.E. 1971. Social Class and College Performance. *College Board Review.* 35.

TRENT, J.W. and MEDSKER, L.L. 1967. Beyond High School : A Study of 10,000 High School Graduates. Centre for Research and Development in Higher Education, University of California.

TRENT, J. and RUYLE, J. 1965. Variations Flows and Patterns of College Attendance. *College and University.* 41, pp.61-76.

UCCA. 1967. Statistical Supplement to the Fourth Report. London, UCCA.

UCCA. 1975 Twelfth Report 1973/74. UCCA.

UGC. 1968. Enquiry into Student Progress. London, HMSO.

WANKOWSKI, J.A. 1969. Some Aspects of Motivation in Success and Failure at University. SRHE : Report of the Fourth Annual Conference. London, SRHE.

WANKOWSKI, J.A. 1970. Random Sample Analysis : Motives and Goals in Universi Studies. Birmingham, University of Birmingham Educational Survey.

WANKOWSKI, J.A. 1973. Temperament, Motivation and Academic Achievement (2 Vols). University of Birmingham Educational Survey.

WATERSTON, R.W. 1979. Comment to Mathematics Discussion Group. Working Conference on the Transition from Secondary to Tertiary Education. Dundee, 1979.

WATTS, A.G. 1972. Diversity and Choice in Higher Education. London, Routledge and Kegan Paul.

WEIR, C. 1976. Interviews as an aid to selection of Psychology Undergraduates. *Brit. J. Ed. Psych.* 46, pp.88-93.

WEITZ, H., CLARK, M. and JONES, D. 1955. The Relationship Between Choice of a Major Field and Performance. *Educ. and Psych. Meas.* 15, pp.28-38.

WEITZ, H. and COLVER, R.M. 1959. The Relationship between the Educational Goals and the Academic Performance of Women : A Confirmation. *Educ. and Psych. Meas.* 19, pp.373-380.

WERTS, C.E. 1968. The Partitioning of Variance in School Effects Studies. *Am. Ed. Res. J.* 5, pp.311-318.

WESKER, A. 1960. The Wesker Trilogy. London, Cape.

WHELAN, C.J. 1980. Comparative Labour Law - The Art of the Possible? *Modern Law Review.* (1980) - to appear.

WHITEHEAD, F.I.H. 1974. The Relationship of Advanced Level Qualifications to Subsequent Academic Performance of Dental Students. *British Dental Journal.* 137, pp.173-176.

WILLIAMS, E.M. 1950. An Investigation of the value of higher school certificate results in predicting performance in first year university examinations. *British J. Educational Psychology.* 20, pp.83-98.

WILLIAMS, R. 1974. The Association between Cigarette Smoking and Academic Achievement. *Journal of Gen. Psychology.* 25.

WILSON, J.D. 1968. Predicting Student Performance in First Year Arts and Science. *Scottish Educational Studies.* 1, pp 68-74.

WILSON, J.D. 1969. Predicting levels of first year student performance. Unpublished Ph.D, Thesis University of Aberdeen.

WILSON, J.D. 1974. Head-teachers' estimates and student performance. *Scottish Educational Studies.* 6, pp.67-76.

WILSON, J.D. 1978. The Academic Achievement Game : Experience with Entering Students. *Scot. Ed. Review.* 10, No.1., pp.7-18.

WISHART, D. 1969. Clustan 1A : Users' Manual. University of St. Andrews, Computing Laboratory.

APPENDIX B

QUESTIONNAIRE TO INVESTIGATE THE ACADEMIC AND SOCIAL EXPERIENCES OF THE STUDENTS' FIRST YEAR

THE PURPOSE OF THE QUESTIONNAIRE

This questionnaire is about your first year in higher education. We would like to hear about your experiences of teaching and learning over the past year and the relevance of what you did at school.

We are interested in how students have been taught, what they have found useful and what has proved more difficult than they anticipated. We are particularly interested in establishing some of the areas where students have run into problems with their studies.

The questionnaire is aimed both at SCE- and GCE-qualified students, those entering through further education and those for whom there has been a relatively long gap between leaving school and entering higher education. Some students may not have been to Scottish schools; others may by now have decided to leave their institution. Whatever your circumstances, please answer as much as you can. We are very interested in what you have to say.

Because we are dealing with a large number of people, however, it is not possible to interview everyone personally. We are therefore using a postal questionnaire to find out about what you have done and how you feel.

HOW TO ANSWER

For most of the questions we ask you to record your answer by choosing one of several alternatives given to you. To answer, you just put a ring around the number beside the answer of your choice. If none of the answers exactly matches the answer you would like to give or your particular case, choose the one that comes nearest. We should also be very interested in any further comments you write beside the question, but please make sure you always ring an answer as well.

For some questions we ask you to decide how *often* you did something by ringing a number. These questions can be answered in five possible ways from *very often* (represented by the number 5) to *never* (represented by the number 1), as in the example below:

very often				never
5	4	3	2	1

Further on there are similar questions in which you are asked to rate how *hard* you find aspects of your course, how much you *agree* or *disagree* with various statements or how much you were *influenced* by various factors.

Ignore the numbers in the margins. They are just there to help us.

Thank you for your help in answering this questionnaire. If you wish to make any general comments about it, please write them on the back cover.

SOME DETAILS ABOUT YOU

		office use only (4t cont)
1. What was the last school you went to?		
name of school:		
town or village:		
country:		19
2. When did you leave school?	*month:*	20 21
	year: 19	22 23
3. Did you start a sixth year at school? *(count a repeated fifth year as a sixth year)*	*(ring one number)*	
	yes 1	24
	no 2	
4. *Sixth year leavers only (including English sixth form)* How seriously did you consider leaving before your sixth year?	*(ring one number)*	
	seriously ... 1	
	fairly seriously 2	25
	not seriously . 3	
5. How many complete academic years, if any, elapsed between leaving school and entering your present College or University?	less than one . 1	
	one 2	26
	two or three . 3	
	four or more . 4	

6. Please indicate which, if any, of the following you have done before entering your present College or University ... *(ring one number for each item)*	yes	no	
... had a full-time job for more than six months?	1	2	27
... taken a course at University?	1	2	28
... taken a course at College?	1	2	29

7. In your last year of full-time study before you entered higher education did any of your teachers know you well enough to give you useful advice about ... *(ring one number for each item)*	yes	no	
... education and/or training after leaving? ..	1	2	30
... your future job?	1	2	31
... how you could improve your performance in the subjects they taught? .	1	2	32
... personal matters?	1	2	33

And now two questions about yourself ...

8. Please give your date of birth: *(e.g. 21/May/1958)*	.../......../19... *day month year*	d:34 35 m:36 37 y:38 39
9. Please give your sex:	male 1	40
	female 2	

-344-

	office use (41 cont)
If you took both SCE and GCE exams please answer all of pages 2 and 3.	
If you took only Scottish (SCE) exams please answer questions 1, 2, 3 and 4.	
If you took only English (GCE) exams please answer questions 5, 6 and 7.	
If you took neither SCE nor GCE exams please tick here .... and go to page 4.	41

1. How many SCE O grade subjects did you pass? ..... *subjects* — 42 43
   (only count grades A, B and C as a pass)

2. How many subjects did you sit for the Highers exam ...
   - ... in your fifth year at school? ..... *subjects* — 44
   - ... in your sixth year, or while repeating fifth year (including resits)? ..... *subjects* — 45
   - ... since leaving school? ..... *subjects* — 46

3. What results did you obtain in Highers?

Please ring the grade you obtained in each subject you sat: A, B, C, O for a 'compensatory O grade' pass given for a Highers attempt, or N for 'no award'. Answer separately for fifth and sixth year presentations, and those made after leaving school. — (42 card) 1 - 9

	grades obtained in fifth year at school	grades obtained in sixth year or while repeating fifth year	exams sat since leaving school	office use
Accounting	A B C O N	A B C O N	A B C O N	10-12
Art	A B C O N	A B C O N	A B C O N	13-15
Biology	A B C O N	A B C O N	A B C O N	16-18
Chemistry	A B C O N	A B C O N	A B C O N	19-21
Economics	A B C O N	A B C O N	A B C O N	22-24
Economic History	A B C O N	A B C O N	A B C O N	25-27
Engineering Drawing	A B C O N	A B C O N	A B C O N	28-30
Engineering Science	A B C O N	A B C O N	A B C O N	31-33
English	A B C O N	A B C O N	A B C O N	34-36
French	A B C O N	A B C O N	A B C O N	37-39
Geography	A B C O N	A B C O N	A B C O N	40-42
German	A B C O N	A B C O N	A B C O N	43-45
History	A B C O N	A B C O N	A B C O N	46-48
Home Economics (Fabrics & Fashion) ..	A B C O N	A B C O N	A B C O N	49-51
Home Economics (Food & Nutrition) ..	A B C O N	A B C O N	A B C O N	52-54
Italian	A B C O N	A B C O N	A B C O N	55-57
Latin	A B C O N	A B C O N	A B C O N	58-60
Mathematics	A B C O N	A B C O N	A B C O N	61-63
Modern Studies	A B C O N	A B C O N	A B C O N	64-66
Music	A B C O N	A B C O N	A B C O N	67-69
Physics	A B C O N	A B C O N	A B C O N	70-72
Other Subjects *(please specify and ring your grade(s) for each subject)*				(43 card) 1 - 9
....	A B C O N	A B C O N	A B C O N	10-12
....	A B C O N	A B C O N	A B C O N	13-15
				subj: 16 17
				18 19

office use (43 cont)

4. Did you start to study any subject(s) for the Certificate of Sixth Year Studies (CSYS)? yes . . . . 1 no . . . . 2 — 20

IF YES: For any subject(s) you started to study for CSYS but never sat in the exam, please ring 'S'. For any subject(s) you sat for the CSYS exam, ring the grade you obtained: A, B, C, D, E, or N for 'no award'.

								office use
English	A	B	C	D	E	N	S	21
Biology	A	B	C	D	E	N	S	22
Chemistry	A	B	C	D	E	N	S	23
Physics	A	B	C	D	E	N	S	24
Mathematics I	A	B	C	D	E	N	S	25
Mathematics II	A	B	C	D	E	N	S	26
Mathematics III	A	B	C	D	E	N	S	27
French	A	B	C	D	E	N	S	28
German	A	B	C	D	E	N	S	29
Italian	A	B	C	D	E	N	S	30
Russian	A	B	C	D	E	N	S	31
Spanish	A	B	C	D	E	N	S	32
Gaelic	A	B	C	D	E	N	S	33
History	A	B	C	D	E	N	S	34
Latin	A	B	C	D	E	N	S	35
Economics	A	B	C	D	E	N	S	36
Art and Design	A	B	C	D	E	N	S	37
Secretarial Science . .	A	B	C	D	E	N	S	38
Geography	A	B	C	D	E	N	S	39
Engineering Science . .	A	B	C	D	E	N	S	40

5. How many GCE O level subjects (not Scottish SCE O grades) have you ever passed (counting resits of failed subjects)? .... *subjects* — 41 42

6. How many GCE A level subjects have you ever attempted (not counting resits)? .... *subjects* — 43

(44 card) 1-9

7. What results did you obtain in GCE A level?
For each subject you attempted, please write in its name (if necessary) and ring the grade you obtained. If you repeated a subject at school please give your best result. Answer separately for attempts made at school and those made after school. Ring O for 'compensatory O level' given for an A level attempt, and N for 'no award'.

	grades obtained at school							exams sat since leaving school							at	since
English	A	B	C	D	E	O	N	A	B	C	D	E	O	N	10	20
Biology	A	B	C	D	E	O	N	A	B	C	D	E	O	N	11	21
Chemistry	A	B	C	D	E	O	N	A	B	C	D	E	O	N	12	22
Physics	A	B	C	D	E	O	N	A	B	C	D	E	O	N	13	23
French	A	B	C	D	E	O	N	A	B	C	D	E	O	N	14	24
German	A	B	C	D	E	O	N	A	B	C	D	E	O	N	15	25
History	A	B	C	D	E	O	N	A	B	C	D	E	O	N	16	26
Geography	A	B	C	D	E	O	N	A	B	C	D	E	O	N	17	27
British Constitution . .	A	B	C	D	E	O	N	A	B	C	D	E	O	N	18	28
Economics	A	B	C	D	E	O	N	A	B	C	D	E	O	N	19	29

Other subjects *(please specify and ring your grade(s) for each)*.

....	A	B	C	D	E	O	N	A	B	C	D	E	O	N	30	33
....	A	B	C	D	E	O	N	A	B	C	D	E	O	N	31	34
....	A	B	C	D	E	O	N	A	B	C	D	E	O	N	32	35

subj: 36 37
38 39
40 41

STUDYING AT SCHOOL

This page is about how you studied during your last year of ***full-time*** *education at school before you started your present course. If you attended an F.E. College please answer in terms of that experience.*

office use (44 cont)

1. We should like to know roughly how often you studied in each of the following ways in school hours during your last year at school.

The ways you studied may have differed for different subjects and different times of the year, so please try to make an 'on balance' judgement of how often you studied in each of these ways. Please ring one number per line.

		very often	often	some-times	rarely	never	office use
a	having notes dictated to you in class . . .	5	4	3	2	1	42:a
b	making your own notes from lessons	5	4	3	2	1	43:b
c	using duplicated notes	5	4	3	2	1	44:c
d	exercises, worked examples, proses, translations	5	4	3	2	1	45:d
e	preparing essays or dissertations	5	4	3	2	1	46:e
f	reading	5	4	3	2	1	47:f
g	class/group discussion	5	4	3	2	1	48:g
h	laboratory/field work and writing up	5	4	3	2	1	49:h
j	creative activity: painting, music, creative writing, etc.	5	4	3	2	1	50:j
k	practical activity: typing, making things, etc.	5	4	3	2	1	51:k

2. Of the above methods of study ...

... which did you most enjoy?	*write its letter here:*	52 53
... which helped most with your exams?	*write its letter here:*	54 55
... which helped you to learn most about things that interested you?	*write its letter here:*	56 57

3. Please think back to the second term of your last year at school. We should like to know roughly how many hours you spent each day, both during and after school time, on the following activities. *Obviously not all days would be the same, but try to make an 'averaged' judgement.*

On an average weekday I spent ...

Your answers to 3a should roughly add up to an average weekday's work.

Ring once per line.

		rough estimate of hours									
a.	... working for Highers	None	1	2	3	4	5	6	7	8+	58
	... working for Sixth Year Studies . .	None	1	2	3	4	5	6	7	8+	59
	... working for GCE A levels	None	1	2	3	4	5	6	7	8+	60
	... working for other exams	None	1	2	3	4	5	6	7	8+	61
	... working, but not for an exam . . .	None	1	2	3	4	5	6	7	8+	62

b. How much of this time was spent working by yourself in private study (in, after or outside school, for any purpose, whether alone or

APPLYING FOR AND ENTERING ST. ANDREWS

office use (45 card)

1. Were you still taking a course at St. Andrews in May 1977?
   - yes 1
   - no 2

   69

2. Will you be taking a course at St. Andrews in October 1977?
   - yes 1
   - no 2
   - don't know . . 3

   70

3a. What type of degree (at St.Andrews) did you give as your primary choice on your UCCA form? *Please ring one number.*
   - Ordinary . . . 1
   - Joint honours . 2
   - Single honours 3

   71

3b. What qualification did this course lead to? *Please ring one number.*

MA Ordinary . .	1	BSc Honours	4	M Theol Ordinary	7
MA Honours . .	2	BSc Med.Sci.(Ordinary)	5	M Theol Honours	8
BSc Ordinary . .	3	BSc Med.Sci.(Honours) . .	6	BD Ordinary	9

72

3c. If you chose an honours degree, what subject(s) did you indicate on the UCCA form? *Please ring the appropriate number(s) on the list below. For joint courses (e.g. English and French) ring both elements (i.e. 12 and 14).*

(45 card 1 - 9)

Anatomy	1	Fine Arts	13	Latin	25	Physics	36
Arabic Studies	2	French	14	Linguistics	26	Physics with Electronics	37
Astronomy	3	Geographical Studies	15	Logic & Metaphysics	27	Physiology	38
Biblical Studies	4	Geography	16	Maths (Pure)	28	Psychology	39
Biochemistry	5	Geology	17	Maths (Applied)	29	Russian	40
Botany	6	German	18	Medicine	30	Spanish	41
Chemistry	7	Greek	19	Medical Biology	31	Statistics	42
Classical Studies	8	Hebrew	20	Modern Russian Studies	32	Theology	43
Computational Science	9	Hispanic Languages & Literature	21	Moral Philosophy	33	Theology with Social Studies	44
Divinity	10	History (Ancient)	22	Music	34	Theoretical Physics	45
Economics	11	History (Mediaeval)	23	Philosophy	35	Zoology	46
English	12	History (Modern)	24				

1 - 3 - 9 - 1

10 11
12 13
14 15
16 17

Other *(please specify)* 47

18 19
20 21

4. Have you now (as of September 1977) changed your primary intention from that stated on your UCCA form?
   - yes 1
   - no 2

   22

   IF YES: To what type of degree?
   - Ordinary . . . 1
   - Joint honours . 2
   - Single honours 3

   23

   To what type of qualification? *Please write in the number from the list in question 3b above.*
   number .... *(from 3b)* 24

   If Honours, in what subject(s)? *Please write in the number(s) of the subject(s) from the list in question 3c above.*
   number(s)........ *(from 3c)* 25 26

TEACHING AND LEARNING IN YOUR FIRST YEAR

We would like to find out what your experience of teaching and learning has been in your first year of higher education.

Please print in the names of the main classes (or subjects) you have taken this past year in the spaces provided at the top of the opposite page. If you took more than four, please choose the most important ones for your course.

Then please answer questions 1, 2 and 3 on this page and the next for each class (or subject). You will probably find it easier to answer all three questions for the first class (or subject) before you answer the same questions about the second class you have written down and so on.

1. How much of the content of this past year's work in the class (or subject) had you previously covered?

Ring the number opposite the statement that best applies to you for each class.

	(1)	(2)	(3)	(4)
most or all	1	1	1	1
quite a lot, including many of the concepts and techniques and much of the content .	2	2	2	2
a few of the concepts and techniques, and some of the content	3	3	3	3
little or none, but the class picked up where my previous knowledge left off . .	4	4	4	4
there was a gap between my previous knowledge and the starting point of this year's class	5	5	5	5

2. When you started the class (or subject) you have indicated above, were you already familiar with the way the subject was taught?

Ring the number opposite the statement that best applies to you for each class.

	(1)	(2)	(3)	(4)
I was already familiar with the way the subject was taught	1	1	1	1
some aspects of the teaching were new . . .	2	2	2	2
most aspects of the teaching were new . . .	3	3	3	3
the way the subject was taught was completely new to me	4	4	4	4

Please check that you have ringed one number for both questions in each of columns (1), (2), (3) and also (4) if appropriate.

office use (45 card)

Please print the names of your main classes (or subjects) here:

(1) . . . . (1) 31-35

(2) . . . . (2) 36-40

(3) . . . . (3) 41-45

(4) . . . . (4) 46-50

Question 1: (1) 51 (2) 52 (3) 53 (4) 54

Question 2: (1) 55 (2) 56 (3) 57 (4) 58

3. How hard or easy did you find this past year's work in the class (or subject)?

Please rate each class on the following points by ringing one number per line, for each class.

(46 card) 1 - 9

	(1) hard so so easy	(2) hard so so easy	(3) hard so so easy	(4) hard so so easy	(1)(2)(3)(4)
techniques: e.g. syntax, grammar, formulae, experimental skills, writing	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	10-13
concepts, theory or general approach	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	14-17
amount of work	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	18-21
demands on your memory . . .	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	22-25
demands on your ability . .	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	26-29
demands on your capacity to get on with it by yourself	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	30-33
knowing what academic qualities your teachers look for in your work . .	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	34-37
practical problems: access to books, equipment, etc.	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	5 4 3 2 1	38-41

Please check that you have ringed one number per line in each of columns (1), (2), (3) and also (4) if appropriate.

4. Have you taken any other classes (or subjects) during your first year that you have not written down in the spaces at the top of the page?

yes . . 1
no . . 2 — 42

IF YES: Please print their names here:

(5) 43-47

(6) 48-52

PREPARING FOR UNIVERSITY

(office use: 46 cont)

1. Thinking about the applications you made for October 1976 were you ...

			office use
... admitted to the course of your first choice?	yes 1	no 2	58
... admitted to the institution of your first choice?	yes 1	no 2	59

2. *If you received a conditional offer from St. Andrews:* Were you required ... *(please ring one number per line)*

	yes	no	office use
... to take an SYS subject(s)?	1	2	70
... to get a specified grade(s) at SYS?	1	2	71
... to sit GCE A level(s)?	1	2	72
... to get a specified grade(s) at GCE A level?	1	2	73

3. How hard did you work ...
For each line please ring one number to show how hard you worked:

Students with some SCE qualifications	very hard				hardly at all	*Students with GCE qualifications only*	office use
... in your fifth year?	5	4	3	2	1	in your lower Sixth?	74
... in your sixth year?	5	4	3	2	1	in your upper Sixth?	75
... at your 'conditional offer' subjects, if applicable?	5	4	3	2	1	at your 'conditional offer' subjects, if applicable?	76
... during your first year at University?	5	4	3	2	1	during your first year at University?	77

4. Did you receive the first offer of a University place that you wanted during your sixth year/form work? yes ..... 1 no ..... 2 — 78

	much increased effort		no effect		serious work abandoned	office use
IF YES: How did it affect the effort you put into your sixth year/form work?	5	4	3	2	1	79

(47 card) 1 – 9

5. On balance, what do you feel about your last year at school? *For each of the following statements please ring one number to show how strongly you agree or disagree with it. The '?' means 'can't say' or 'neutral'.*

My last year at school ...

	strongly agree				strongly disagree	office use
... gave me good opportunities to follow up subject interests	5	4	?	2	1	10
... helped me with my methods of studying	5	4	?	2	1	11
... gave me good experience of organising my own study for myself	5	4	?	2	1	12
... gave me too little freedom	5	4	?	2	1	13
... gave me too much freedom	5	4	?	2	1	14
... helped me to understand specific university courses	5	4	?	2	1	15
... gave me a better relationship with my						

CHOOSING SUBJECTS TO STUDY

(office use: 48 card 1 – 9)

1. When you chose your subjects for first year study, was one definitely a third subject which you intended to study for one year only? yes . 1 no . 2 — 36

IF YES: Which subject? .... — 37-39

Is it still your intention to drop that subject after first year? yes . 1 no . 2 — 40

2. Please ring up to three subjects on the following list which you would have liked to have taken, had they been available in first year as a graduating course.

						office use
Accountancy	1	Ecology	6	Italian	11	60 61
Archaeology	2	Economic History	7	Legal Studies	12	62 63
Communications	3	Ethology	8	Marine Biology	13	64 65
Demography	4	European Studies	9	Politics	14	66 67
Drama	5	Genetics	10	Social Anthropology	15	68 69

3. Please underline any subject(s) on the list above which you would have liked to have taken for more than one year, if they had been available. — 70 71

(49 card) 1 – 9

4. Thinking about your present institution and course.
Are you satisfied with ...

			office use
... your present institution?	yes . 1	no . 2	10
... your present course?	yes . 1	no . 2	11

SOURCES OF DIFFICULTY

1. Which of your first year subjects did you find most difficult?

Please write its name here: .... — 12-14

Why did you have difficulty with this subject?
Please write your reasons in the space below. — 15 16

17-19

20-22

-348-

STUDYING AT COLLEGE OR UNIVERSITY

office use (50 card) 1 – 9 — 1.

1. Please indicate roughly how often you have studied in each of the following ways during the second term of your present course.

The ways you studied may have differed for different subjects and different times of the term, so please try to make an 'on balance' judgement of how often you studied in each of these ways.
Please ring one number per line.

		very often	often	sometimes	rarely	never	
a	having notes dictated to you in lectures .	5	4	3	2	1	10:a
b	making your own notes from lectures . . .	5	4	3	2	1	11:b
c	using duplicated notes	5	4	3	2	1	12:c
d	exercises, worked examples, proses, translations	5	4	3	2	1	13:d
e	preparing essays or dissertations	5	4	3	2	1	14:e
f	reading	5	4	3	2	1	15:f
g	tutorial/group discussion	5	4	3	2	1	16:g
h	laboratory/field work and writing up . . .	5	4	3	2	1	17:h
j	creative activity: painting, music, creative writing etc.	5	4	3	2	1	18:j
k	practical activity, other than above . .	5	4	3	2	1	19:k

2. Of the above methods of study ...

... which did you most enjoy?	*write its letter here .....*	20 21
... which helped most with your exams?	*write its letter here .....*	22 23
... which helped you to learn most about things that interested you?	*write its letter here .....*	24 25

3. How have you got on with your studies this past year? *Here are some statements. For each one please ring one number to show how strongly you agree or disagree with it. '?' means 'can't say' or 'neutral'.*

	strongly agree				strongly disagree	
I have had problems with my studies this past year	5	4	?	2	1	26
I have had all the personal help I needed from my lecturers and advisers	5	4	?	2	1	27
I have seriously considered giving up my course and leaving	5	4	?	2	1	28

2.

4. *Please answer questions 4a and 4b if you have had study problems this past year.*

3a.

a. What happened?

	strongly agree				strongly disagree	
I tried to sort out by myself any study problems I had	5	4	?	2	1	29
I talked over study problems with other students	5	4	?	2	1	30
I talked over study problems with members of staff	5	4	?	2	1	31

b.

4.

b. When did you first realise you might be having problems with your studies? During your ...

first term	1	
second term	2	32
third term	3	

SELECTED STUDY HABITS

The statements below concern the ways you now work at university or college. *We are interested in your immediate response to each item. Please work quickly through these statements indicating the extent of your agreement or disagreement by circling the number that best corresponds to your immediate feelings. It might help to think of the numbers 9 - 1 as though they were a 'register' of your amount of agreement or disagreement. '?' means 'can't say' or 'neutral'. It is most important that you answer each item even though your feelings may be rather vague or may not correspond to the exact wording of the statement.*

office use (56 cols)

Work quickly through the statements ringing one number per line	strongly agree 9	8	7	6	?	4	3	2	strongly disagree 1	office use
I try to study at regular times each day	9	8	7	6	?	4	3	2	1	33
I tend to put off work, leaving too much to do at the last minute	9	8	7	6	?	4	3	2	1	34
I prefer to work steadily from day to day, not in fits and starts	9	8	7	6	?	4	3	2	1	35
I try to work for short periods with frequent rest breaks	9	8	7	6	?	4	3	2	1	36
I find it difficult to work for more than an hour at a time	9	8	7	6	?	4	3	2	1	37
I sometimes get disheartened and lose interest if something is too difficult for me	9	8	7	6	?	4	3	2	1	38
I have difficulty in organising my own work . . .	9	8	7	6	?	4	3	2	1	39
I try to summarise in a systematic way what I have learned each week	9	8	7	6	?	4	3	2	1	40
I have difficulty remembering things I have read soon afterwards	9	8	7	6	?	4	3	2	1	41
I easily get distracted when I am studying	9	8	7	6	?	4	3	2	1	42
Without exams I should not study very much	9	8	7	6	?	4	3	2	1	43
I am used to organising my own work	9	8	7	6	?	4	3	2	1	44
My hobbies are mainly related to academic subjects	9	8	7	6	?	4	3	2	1	45
I try to revise every topic for exams	9	8	7	6	?	4	3	2	1	46

-349-

During the first year of your present course have any of your lecturers known you well enough to give you useful advice about ...

... how you could improve your performance in the subjects they taught? yes . 1 / no . 2 — 47

... personal matters? yes . 1 / no . 2 — 48

Have you been required to resit any of your first year exams? yes . 1 / no . 2 — 49

IF YES: Have you resat them at the time of answering this questionnaire? yes . 1 / no . 2 — 50

How strongly do you want to take Honours?
Please ring one number.

- at all costs 1
- a great deal 2
- a great deal - but not at the expense of other interests . 3
- somewhat . . . . 4 — 51
- undecided/hardly at all . . . 5
- want to take Ordinary (Pass)

* answer 'not relevant' if your course is for a diploma/certificate or any which offers only

LIFE AT COLLEGE OR UNIVERSITY

1. The statements below concern certain opinions about life at university or college. We are interested in the extent to which you agree or disagree with them. *For each statement please ring one number.*

	strongly agree				strongly disagree	office use (51 card) 1 - 9
there is little point in going on to college or university as few graduates seem to be able to find suitable jobs	5	4	?	2	1	10
my college/university environment is socially stimulating	5	4	?	2	1	11
my college/university environment is academically stimulating	5	4	?	2	1	12
the exam system merely breeds competitiveness . . .	5	4	?	2	1	13
the whole college/university experience is a good basis from which to cope with the outside world .	5	4	?	2	1	14
college/university is merely another way of institutionalising and dehumanising people . . .	5	4	?	2	1	15
college/university life gives you the scope and flexibility to do what is best for you	5	4	?	2	1	16

2. In an average week of your second term, roughly how many hours did you spend ...

		office use
... doing your own personal academic work? (ie. excluding lectures, tutorials, lab work, etc.)	...... *hours a week*	18 19
... in social activities?	...... *hours a week*	20 21

3. Now think about an average first year student on your course(s). In an average week of the second term, roughly how many hours do you think he/she spent ...

		office use
... doing personal academic work? (i.e. excluding lectures, tutorials, lab work, etc.),	...... *hours a week*	22 23
... in social activities?	...... *hours a week*	24 25

	very satisfied				very dis-satisfied	office use
4. How satisfied are you with your university or college as an academic institution?	5	4	?	2	1	66
How satisfied are you with your social life at your university or college?	5	4	?	2	1	67
5. How satisfied do you think first year students in general are with your university or college as an academic institution?	5	4	?	2	1	68
How satisfied do you think first year students in general are with social life at your university or college?	5	4	?	2	1	69

YOUR HOME AND YOUR FAMILY

1. Where did you stay for the most part during your first year? *Please ring one number.* (office use: (52 card) 1 - 9)

at home of parent/guardian	1	
university or college hall of residence	2	
university or college flat or lodgings	3	
other lodgings, flat, bedsitter, house: – with other students	4	
– without students .	5	
elsewhere	6	

2. How long did it take you, on average, to travel from this address to classes?

		office use
under 30 minutes .	1	10
31 – 60 minutes . .	2	
61 – 90 minutes . .	3	11
over 90 minutes . .	4	

3. Did you change your term-time address during your first year?

		office use
yes	1	12
no	2	

4. Did you have adequate facilities for studying at your main term-time address?

		office use
yes	1	13
no	2	

Finally, a few questions about your family background. Your answers are strictly confidential. We will not attempt to identify any of the individuals concerned.

5. How many brothers and sisters do you have? *(Please write '0' if none)*

	office use
.... brothers	14 15
.... sisters	16 17

6. At what age did your parents finish their full-time education? *(Ring one number for each parent, if applicable)*

	mother	father	office use
15 years or less .	1	1	
16 years	2	2	
17 years or more .	3	3	18 19
don't know	4	4	
not applicable . .	5	5	

350q

7. Could you please tell us a little about your father's job? *(If he is not working at the moment, please describe his last job)*

a In what type of business does he work? *(eg. shipyard, electrical engineering firm)* 20 21

b What is the name of his job? *(Please also mention his rank or any special qualifications that he holds)* 22-24

c Please describe briefly the work he does in his job. 25

d Is he self-employed? *(Ring one number)*

		office use
yes	1	26
no	2	

8. Has your mother ever taught or been trained as a school teacher?

		office use
yes	1	27
no	2	
not applicable . .	3	

THANK YOU FOR YOUR HELP.

28 29

APPENDIX C

QUESTIONNAIRE FOR SURVEY INTO THE STUDENTS' REASONS FOR CHOOSING AN ORDINARY DEGREE

1. When you arrived at St. Andrews was it your intention to study for an ordinary or an honours degree? ....

2. Now, at the end of your second year, do you wish to enter honours or will you study for an ordinary degree? ....

Next, would you please answer:-

<u>SECTION A:</u> if your answer to questions 1 & 2 was ORDINARY
<u>SECTION B:</u> if your answer to questions 1 & 2 was HONOURS
<u>SECTION C:</u> if you changed from ORDINARY to HONOURS
<u>SECTION D:</u> if you changed from HONOURS TO ORDINARY.

SECTION A

1. Why did you choose to do an ordinary degree? (Please tick any of those which apply to you)

   a) offered a greater variety of courses
   b) it fitted in with your future career objectives
   c) advice from school, parents etc.
   d) felt an honours course would strain you academically
   e) did not want to spend 4 years on a degree
   f) other (please specify).

2. In 1977 or previously did you pass or gain exemption from three whole subjects? ....

SECTION B

1. How would you grade your chances of being accepted into an honours class?

   a) excellent
   b) very good
   c) 50 : 50
   d) unlikely
   e) poor.

SECTION C

1. Why did you intend to follow an ordinary degree course when you arrived at St. Andrews? (Please tick any which apply to you)

a) advice from parents, school etc.
b) it fitted in with your future career objectives
c) greater variety of courses
d) felt an honours course would strain you academically
e) did not want to spend 4 years on a degree
f) other (please specify).

2. Why did you change? (Please tick any which apply to you)

a) discovered a particular interest in one subject
b) standard of your passes at first year
c) advice from your advisor of studies
d) other (please specify).

3. How do you grade your chances of being accepted into an honours class

a) excellent
b) very good
c) 50 : 50
d) unlikely
e) poor

SECTION D

1. Why did you change from an honours to an ordinary degree course? (Please tick those which apply to you)

a) did not pass or gain exemption in 3 subjects at first year
b) disillusioned with subject and/or course
c) change of future career objectives
d) have found the academic standard higher than you expected
e) personal (e.g. marriage)
f) other (please specify)

APPENDIX D : CODING SHEET FOR DATA ON THE UNIVERSITY CAREERS OF ENTRANTS TO ST. ANDREWS IN 1971, 1972, 1973.

Each students' record consists of 11 cards. Card 1 contains data on the students' personal characteristics and also on the final outcome of the course. Cards 2 to 6 cover the students' school qualifications and Cards 7 to 11 have the results of each course taken by the student during their University career. The variables follow:

CARD 1

V1 : Year of Entry (71, 72, 73)

V2 : Sequence number for each student within each year.

V3 : Card number (i.e. 1)

V4 : Date of Birth (Day, month, year)

V5 : Sex : 1 = Male; 2 = Female.

V6 : Faculty of Entry :
- 1 = Arts
- 2 = Science
- 3 = Divinity
- 4 = Medicine

V7 : Date of leaving University : Month, Year.

V8 : Class of degree :

00 : Uncompleted	09 : Ordinary degree after Honours exam.
01 : First	10 : Ordinary
02 : Upper Second	11 : Leave before end of Year 1
03 : Lower Second	12 : Leave before end of Year 2
04 : Undivided Score	13 : Leave before end of Year 3
05 : Third	14 : Leave before end of Year 4
06 :	15 : Leave before end of Year 5
07 :	16 : Leave before end of Year 6
08 : Aegrotat	

V9 : Reason for Leaving :

0 Successful completion : to graduate	5 Death
1 Successful completion : graduated	6 Other
2 Studies discontinued	7
3 Unknown	8 Transferred to other University.
4 Health	
	9

V10 : County of domicile : A three digit code.

V11 : Country of Birth.

V12 : Nationality.

V13 : Home/Overseas.

V14 : Parents' occupation (Using Registrar Generals (1961) Coding)

V15 : School (Using S.C.E.E.B. coding)

V16 : School Type (Using S.C.E.E.B./U.C.C.A. coding)

V17 : Date of Leaving School : Year, Month.

V18 : Previous Further Education 1 = Yes 0 = No

V19 : Other Qualifications 1 = Yes 0 = No

CARD 2 : PERFORMANCE IN SPECIFIED HIGHERS SUBJECTS : GRADE A = 3; B = 2; C = 1.

V20 V21	ACCOUNTING
V22 V23	ART
V24 V25	BIOLOGY
V26 V27	CHEMISTRY
V28 V29	ECONOMICS
V30 V31	ECONOMIC HISTORY
V32 V33	ENGINEERING DRAWING
V34 V35	ENGINEERING SCIENCE
V36 V37	ENGLISH
V38 V39	FRENCH
V40 V41	GEOGRAPHY
V42 V43	GERMAN
V44 V45	HISTORY
V46 V47	HOUSEHOLD MANAGEMENT
V48 V49	ITALIAN
V50 V51	LATIN

For each Highers subjects there are two variables, the first denoting the students' performance in fifth year and the second performance in sixth or a subsequent year.

V52	MATHEMATICS
V53	
V54	MUSIC
V55	
V56	PHYSICS
V57	
V58	SPANISH
V59	

CARD 3 : PERFORMANCE IN HIGHERS SUBJECTS NOT COVERED IN CARD 2. GRADES A= 3; B = 2; C = 1.

V60	Subject Coding : See Appendix E(i)
V61	Performance in Year 5
V62	Performance in Year 6 or subsequent year
V63	Subject Coding : See Appendix E(i)
V64	Performance in Year 5
V65	Performance in Year 6 or subsequent year.

CARD 4 : PERFORMANCE IN CERTIFICATE OF SIXTH YEAR STUDIES. GRADES A = 6; B = 5; C = 4; D = 3; E = 2; DID NOT SIT = 1.

V66	ENGLISH
V67	BIOLOGY
V68	CHEMISTRY
V69	PHYSICS
V70	MATHEMATICS I
V71	MATHEMATICS II
V72	MATHEMATICS III
V73	FRENCH
V74	GERMAN
V75	ITALIAN
V76	RUSSIAN
V77	SPANISH
V78	GAELIC
V79	HISTORY
V80	LATIN
V81	ECONOMICS
V82	GEOGRAPHY

CARD 5 : OTHER CSYS SUBJECTS

V83 Subject Code : See Appendix E(i)
V84 Performance
V85
V86 Subject Code : See Appendix E(i)
V87 Performance
V88

CARD 6 : GCE A LEVEL PERFORMANCE

V89 Subject Coding : See Appendix E(i)
V90 Performance at first attempt
V91 Performance at a second attempt
V92 - V103 : up to four additional A levels : codes as for V89-V91.

CARDS 7 :- 11 UNIVERSITY PERFORMANCE

CARD 7 : UNIVERSITY FIRST YEAR PERFORMANCE

V104	Number of Subjects Taken in Year	
V105	Type of Course (i.e. 1st B.Sc. General, etc.)	Two Digit Code
V106	Subject Code	Three Digit Code
V107	Result	Two Digit Code

V108 - V109 : up to four additional subjects : codes as for V105-V107.

CARD 8 : UNIVERSITY SECOND YEAR PERFORMANCE

V120 - V135

Codes as for Card 7.

CARD 9 : UNIVERSITY THIRD YEAR PERFORMANCE

V136 - V151

Codes as for Card 7.

CARD 10 : UNIVERSITY FOURTH YEAR PERFORMANCE

V152 - V167

Codes as for Card 7.

CARD 11 : UNIVERSITY FIFTH YEAR PERFORMANCE

V168 - V183

Codes as for Card 7.

In addition, the file holds numerous derived variables such as Total number of Highers passed, Entrance Qualification Score and Overall measure of First year performance.