3: Bias in selection.

"Of those hundred and fifty students few were country lads like myself. The greater part came from the surrounding industrial region. They were nearly all middle-class folk, and a large number - between thirty and forty - sons of medical men ... "

Francis Brett Young,

Dr. Bradley Remembers, (1938; p.115).

"The Robbins committee ... heard evidence that a system of university admissions based chiefly on GCE grades was undesirable. This criticism came

from both the schools and the universities..."

Choppin (1979; p.213).

Summary.

The effects of demographic, educational, family, and application factors upon success in admission t ... .

school are analysed in the St. Mary's Study. The inter-related processes of differential application, systematic selection, differential selection, and differential acceptance are analysed ... ...

the variables of interest, in relation to admission to five groups of medical schools. A multiple logistic regression of the overall likelihood of selection showed that the most important overall determinant of success was A-level achievement. In addition O-level achievement, early application, and medical parents were independent predictors of success, although the effects of the latter variables were relatively small. Social class did not predict acceptance. Causal analyses of the determinants of educational achievement and early application are also presented.

Of the 10,810 people who applied through UCCA for admission to medical school in October 1981 only 3997 were

rejection raises public concern as to whether the selection process is fair. It is a common belief, for example, that medical schools tend to select preferentially those who are male, who have been educated at public school, or who are the children of doctors. In this chapter data from the St. Mary's Study is analysed in order to determine whether or not the selection process is 'fair', and by means of an appropriate statistical analysis of this sample of national applications conclusions will be drawn not only for St. Mary's alone, but for the system of selection as a whole.

The variables examined have been demographic (nationality, sex, age, social class and region of domicile), educational qualifications (O- and A-level results, pre- or post-A-level application, subjects taken), type of schooling

(public or private sector, size of school, size of sixth form, number in sixth form going to university), family background (medical parents), and the manner in which the UCCA form has been completed (the number of choices for medicine, the number of London medical schools chosen, the

Method.

The survey has been described in detail in chapter 2.

of questionnaires   and were followed up to find their

were admitted to medical school: 84 (17.3%) to St. Mary's.

subjects) and any that might be being taken at the time of application (usually in science subjects). Scores have been calculated on the basis of 5 points for an A grade, 4 points for a B, 3 for a C, 2 for a D, 1 for an E, and 0 for an O or F. At A-level most applicants offer sciences (usually physics, chemistry, biology and maths) with only a very few offering arts subjects (and then either a single subject in addition to science, or in the case of mature students, subjects taken a number of years earlier). On average each applicant offered 3.15 A-levels (excluding General Studies), with the vast majority taking three A-levels (81.8%), and a

or more than four A-levels (2.1%). The grades of successful applicants in general are substantially higher than those of rejections at both A and O level. On average each candidate

at O-level had taken 4.2 science subjects and 5.0 non-science

large extent these measures encapsulate the essence of Table
3-1, although, some subtleties may be lost.

In order to simplify interpretation of the findings,
only UK nationals are analysed unless specific reference is
made. Figure 3-1 shows the cumulative distributions of
A-level achievement according to the six destination groups
of the applicants. There is a sharp discrimination between
the groups, as might be expected: Oxbridge scored higher
than other acceptances ($F(1,485)=39.82$, $p<0.001$); there was

no difference between St. Mary's, Other London and Non-London
schools ($F(2,444)=1.50$, NS). Those accepted for non-medical
courses had significantly higher grades than those rejected
overall ($F(1,674)=25.42$, $p<0.001$). An A-level achievement
threshold of 3.1 (i.e. an average grade between a B and a C;

or the equivalent of between 9 and 10 points based on three
subjects) correctly groups 83.9% of applicants into
acceptances and rejections: only 8.4% of acceptances gained

less and 22.1% of rejections surpassed it. Although the
ability to achieve high A-level grades is clearly neces-

A-level achievement into consideration, in order to determine
the significance of other factors.

Univariate analsyses of non-academic factors.

is clearly seen in respect to social class. From Table 3-2
it appears that those of higher social class are
significantly more successful in their applications, while
Table 3-3 appears to show no such bias as St Mary's

Neither comparison is valid. Many St. Mary's rejects were

fairness of table 3-3 may itself be illusory. The crude
analyses of tables 3-2 and 3-3 have therefore been replaced
with a more sophisticated multiple regression approach which
allows answers to a number of closely related questions about

four distinct aspects of selection which are called

differential application, systematic selection, differential
selection, and differential acceptances. In so doing it is
conceptually simpler to reverse the questions and ask if one
may predict the social class of an applicant given a
knowledge of other factors about the candidate. The NEW
REGRESSION procedure of the SPSS statistical program (Nie et
al, 1975; Hull and Nie, 1981) has been used for statistical
analysis.

The following questions may be asked:-

From the St. Mary's data one may calculate for each

medical school the mean social class (or any other parameter)

particular university on their UCCA form. Of course this

will not produce an accurate estimate of the actual mean

social class of _all_ applicants to that school, but rather

only of that subset that included St.Mary's on their UCCA

form. Nevertheless such an analysis will allow us to

estimate the _relative_ pattern of social class differences

between medical schools, and will be valid unless there are

very unusual interaction patterns. For descriptive purposes

one may combine these estimates into different types of

regression, after total number of UCCA applications and total

significant increase in the explained variance indicates the

overall differences are significant then the source of the difference is found by considering the confidence limits of the coefficients of each of the individual variables.

ii.) Is there any overall bias in the system?   ('Systematic

Having carried out the analysis in step i.) one may now find the statistical improvement obtained by adding in a variable indicating whether or not an applicant was accepted by any medical school. This tests whether overall there is a systematic trend in the selection system after differences in application pattern are taken into account; whether or not such trends are construed as bias will depend upon assessment of their relevance to the selection process.

school groups. The source of the heterogeneity may be found

only one study has ever explicitly considered such a
possibility, Shuval (1980; p.60) finding differences between
Israeli medical schools in their over-selection of the
children of doctors.

iv.) Are there differences between medical schools in the
individuals that they accept? ('Differential acceptance').

One may answer this question by fitting a series of

differences in educational qualifications into account.

1.) Educational qualifications.

Figure 3-2 shows the O and A-level qualifications of applicants to and acceptances by the medical schools in the five groups.

applicants took more, and S&NI applicants took fewer O-levels

which was due to St.Mary's accepting applicants with higher

numbers of A-levels. The differential acceptance (p<0.001),

having more A-levels.

Mean grade in A-levels. The difference in average A-level

grades between applicants and between entrants to different

schools (p<0.001 for each), was almost entirely due to

highly significant evidence for systematic selection in

favour of high A-level grades. (p<0.001). There was no

A-level maths taken. 39.2% of applicants and 43.7% of

or differential acceptance.

2.) Demographic factors.

i.) Nationality. 178 (13.1%) of the applicants to St.Mary's
were not of British nationality, as determined from their
UCCA form. In contrast only 5.8% of acceptances were not
British.   There was statistically significant evidence of

were taken into account.

iii.) Social class. This has already been discussed earlier.

There was evidence for differential application (Figure 3-3c), because applicants to Oxbridge and London were from a higher social class background. After taking such

differential application into account, acceptances were of higher social class than rejections (p<0.05). There was no

The pattern of differences between schools is almost identical to that found by the Royal Commission on Medical Education (1968), for applicants entering medical school in

systematic selection (p=.102), or differential selection. St. Mary's and E&W had a lower proportion of individuals from

significantly to EQ (p=.016): those from medical families had taken more O-levels and fewer A-levels than other applicants, although average grades were similar. Taking EQ into account, applicants still differed between schools (p=.051), there was a trend towards systematic selection (p=.066) but no evidence of differential selection.

v.) Maturity of applicants. 'Mature' applicants were defined as those who would have reached the age of 21 by 30th September 1981 (i.e. the beginning of the 1981-1982 academic year). 14.8% of applicants and 8.3% of acceptances fitted into this category. Figure 3-3e shows a highly significant differential application (p<0.001) and differential acceptance (p<0.05) most of the effects being due to their lower application rate to Oxbridge. Mature students were

less likely to be accepted (p<0.001) overall, although there was no evidence for differential selection. Mature applicants had significantly lower O- and A-level achievement (p<0.001). Taking these differences into account, schools still differed in their proportions of mature applicants

proportion of northern applicants ($p \le 0.001$) and they were

also more likely to accept northern applicants (p=.027) (Figure 3-3f). Applicants from the north had a slightly higher O-level achievement related to EQ (p=.042) but taking account of this did not affect the above conclusions.

3. Education.

i. Private versus Public Sector education. Applicants were classified according to whether they had received any education in the private sector (i.e. independent public

to take more A-levels (p<0.01), applicants from larger sixth

forms tended to have higher A-level grades (p<0.1) and

tended to have higher A-level grades (p<0.1.) Taking EQ into

account did not alter any of the above conclusions.

4. The UCCA application.

i.) Oxbridge on the UCCA form. 10.3% of applicants and 20.3%

of acceptances had included Oxford or Cambridge on their

application form. Figure 3-5a shows the proportions of

applicants to schools who had included Oxbridge on their UCCA

form (Oxbridge itself being excluded since necessarily all

applicants and acceptances had put it on the form). Although

differential application was not significant, there was

significant evidence for systematic selection (p=0.01), and a

trend towards differential selection. Oxbridge application

correlates highly with EQ (p<0.001), these applicants having

achievement (p<0.001.) Taking this into account did not affect any of the above conclusions.

iii.) _The use of bracketing on the UCCA form._ Candidates may use one or two brackets around their five UCCA choices to indicate equal preference of choices. As a single measure of this the preferential position after taking account of bracketing of the choice that was actually in the fifth position on the UCCA form was used; thus if no brackets were

preference and a score of 5 was given, while if all five choices were bracketed together a score of 1 was given, since the last choice was actually first equal. On average

significant (p<0.001), with Oxbridge applicants being more

likely, and E&W applicants less likely to be post-A-level.
There was no evidence for systematic selection or
differential selection. Differential acceptance (p<0.05),

applicants. Post-A-level applicants had poorer O-level
achievement but better A-level achievement (p<0.001). Taking

(p<0.001), or affect any other results.

v.) Previous UCCA application. 21.3% of applicants and 22.6%

of acceptances had applied to UCCA previously. Figure 3-5e
shows that schools differed in their proportion of previous

accountable by earlier Oxbridge applications. Date of application correlated very significantly with EQ (p<0.001), early applicants having higher O- and A-level achievement, although these differences did not remove the differential application (p<0.001), or the systematic selection (p<0.01.)

1.   ) UK applicants.

Univariate analyses have shown that a large number of factors show some of the four processes of differential

the applicant was accepted at <u>any</u> medical school.
Considering just the 946 UK applicants with complete data on
all variables, the prediction equation based on all 24

p<<0.001). Table 3-4 shows for each variable the effect upon
the relative likelihood of acceptance, the variables being
ranked from most significant to least significant. Only the
first six variables reach the conventional 5% level. Taken
together the last 18 variables do not significantly improve
the fit of the regression equation (Chi-squared = 12.4, 18df,
NS). Table 3-4 shows 95% confidence limits of the relative
likelihood for those variables which are statistically

Four of the six significant predictors are concerned

ii). Non-UK applicants.

Thus far all of the analyses reported have been on those

with United Kingdom nationality. A multiple logistic regression was carried out using the six significant predictors shown in table 3-4, and with the addition of UK nationality as a seventh predictor. After taking the six known predictors into account, UK nationals were 4.44 times as likely to be accepted as non-UK nationals (p<.001; 95% confidence limits 2.09x to 9.45x). There were no interactions between UK nationality and the other six predictors (Chi-squared = 7.2, 6df, NS).

Determinants of educational qualifications.

The average A-level grade obtained by applicants can be determined, in principle, by many factors; previous examination results, the particular mix and number of

From figure 3-6 it can be seen that the four measures of
educational qualifications are all dependent upon background
variables and upon each other.   Private   sector   education
("Public schools") is more likely in those from social class

I and those from medical families.   Private   sector   schools
are smaller, and have smaller sixth forms relative to overall
school size.   Sixth form size has no influence   upon   A-level
results,   but   pupils   at larger schools overall tend to take
more A-levels (but not gain higher   grades   in   them).   The
number of 0-levels taken is higher at private sector schools,
and those taking more 0-levels   also   get   higher   grades   at
0-level.   Grades attained at 0-level determine whether maths
or biology is taken at A-level, higher achievers taking maths

related to the number of A-levels taken,   but   is   higher   in
those taking maths and lower in those taking biology.   Higher

From this analysis it can be seen that although A-level grades are the immediately proximate determinants of acceptance, they are themselves subject to many causal influences throughout the process of secondary education, and that background variables affect them in many ways. Of course the analysis of figure 3-6 considers only those individuals who actually applied to medical school. It is

conceivable, although not likely, that the structural determinants of educational success are different in those who might apply to medical school, but in fact have not.

Determinants of date of UCCA application.

Causal modelling was not felt to be useful for analysing

Early UCCA application was predicted by five of the
background variables (multiple R = 0.368, p<<.001) (see
Figure 3-7). Oxbridge applicants applied 18.9 days earlier

applicants). The number of medical schools on the UCCA form
related to date of application, each extra medical school on
the form being associated with an application 11.4 days
earlier (p<.001). Female applicants applied 6.8 days earlier
(p<.001). and mature applicants applied 15.8 days later

Discussion.

By far the most important factor determining selection

academic qualifications should be only a partial factor in

Linke et al, 1981; Parkhouse, 1979) may be to some extent

justified by the generally poor predictive value of A-levels

necessarily either mean that a proportion of those currently
entering medical schools are <u>unsuitable</u> for medical practice,
or that those individuals currently practicing are not as
professionally competent as could be wished or obtained. The
greatest practical advantage of selection based primarily on
A-level grades, is that it is less likely to be biased by
irrelevant social considerations.

Other factors predicting selection, in particular the
type of school attended and the presence of a medical parent,
are important in so far as they undermine public confidence
in the fairness of the system, but their numerical effect
appears to be relatively small. Of the other important
factors, the inclusion of number and grade of O-levels is

worrying in so far as the predictive value of O-levels for
subsequent medical practice is likely to be minimal, and any

of medical schools. In interpreting these findings it must be remembered that there are many factors which this study

UCCA form has been submitted. However a myriad of factors can bias that process of application arising from school

home or peer group (Mortimore and Blackstone, 1982), and convincing some potential applicants that it not worthwhile either applying for admission, or even perhaps studying appropriate O- and A-level subjects. As a Lancet editorial put it, "When the student chooses which medical school he will apply to, only then do selectors begin to have any direct say" (Anon 1974). That such bias is likely to be

occurring can be inferred from the social class distribution of applicants, which is more exclusive than would be predicted if intellectual ability were the sole determinant of ability to study and practice medicine (McManus, 1982b), and on the basis of other studies of university admission in general (e.g. Halsey et al, 1980).

Figure 3-1: The cumulative distribution of mean A-level grade, according to the eventual destination of applicants.

Grade

St.Mary's
Other London
Non London

Oxbridge

3 C 4 B 5 A
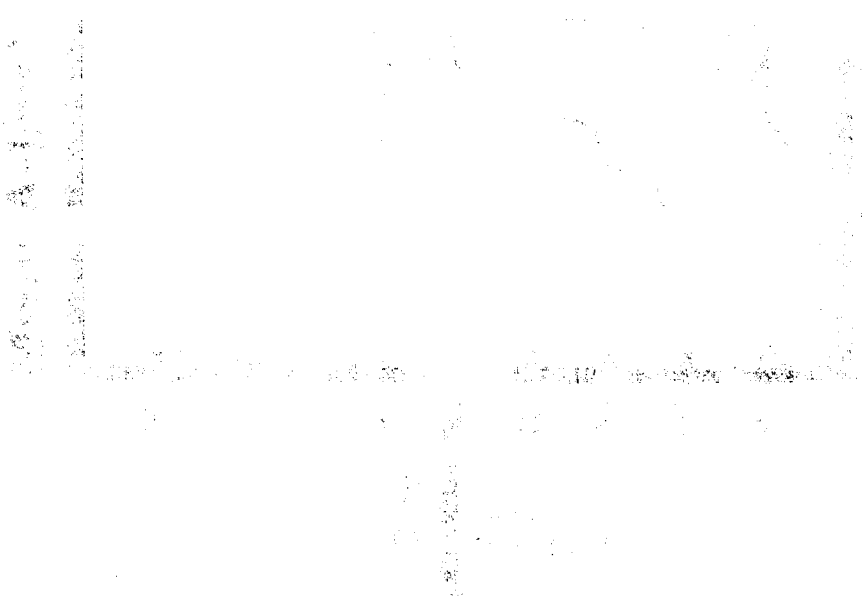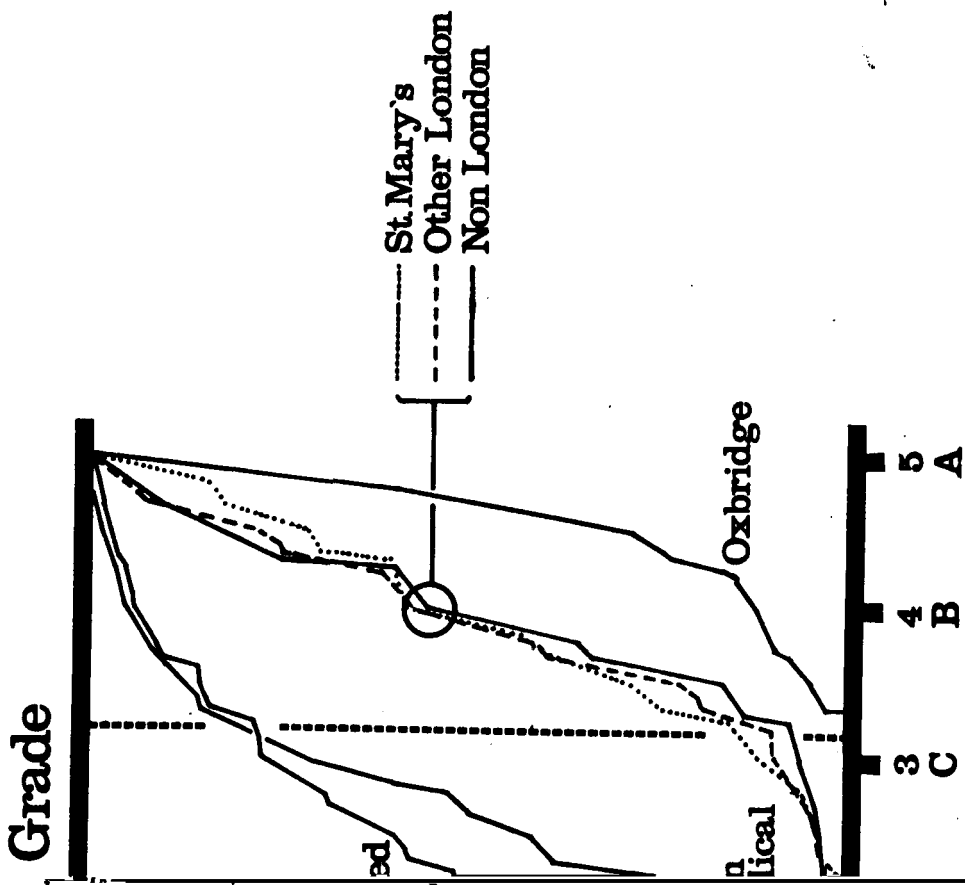
Figure 3-2: Shows the mean number of exams taken (top row)

and averag grades obtained (middle row) at O- and A-level

and the proportion (bottom row) taking A-level biology and

A-level maths, by applicants (open triangles) and acceptances

(solid triangles) to five medical school groups (OC: Oxford

and Cambridge;   SM: St Mary's; L: Other London medical

O-levels

3.5

Acc.

App

A-levels

5

Mean O-level grade

Mean A-level grade

4

3

2

A-level biology

60

50

40

A-level maths
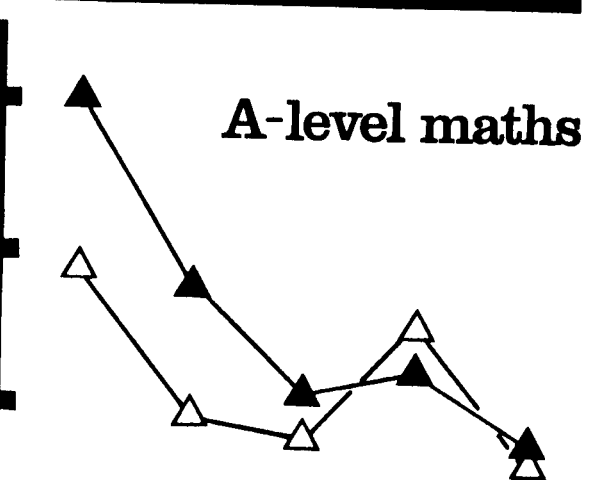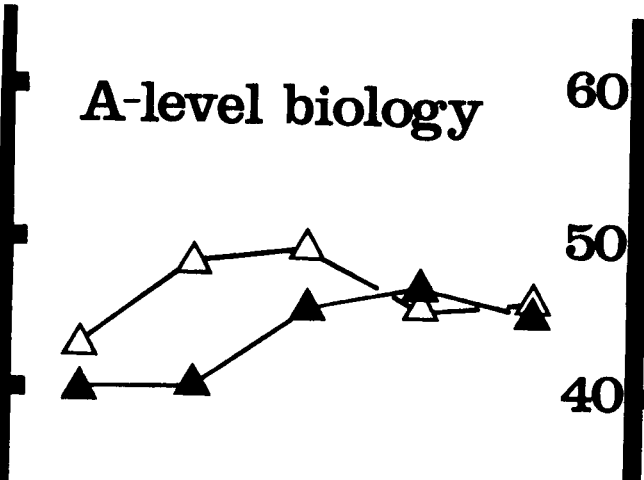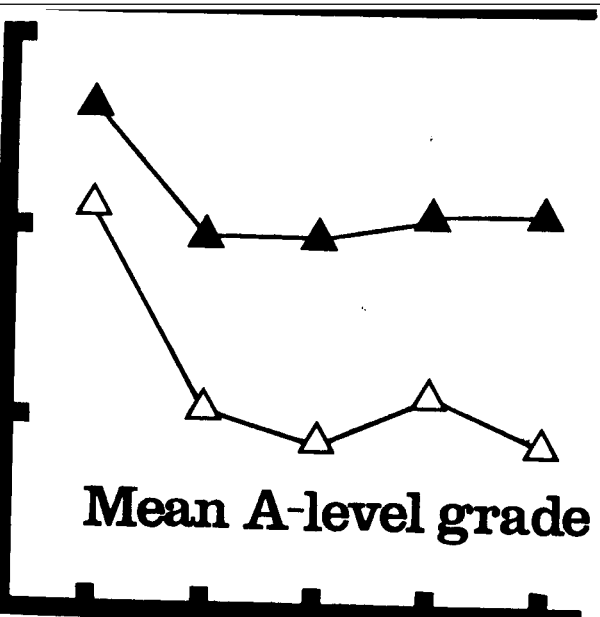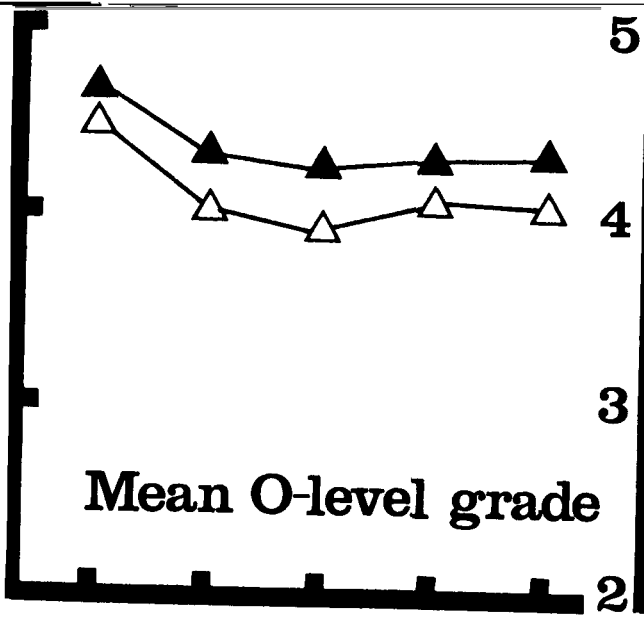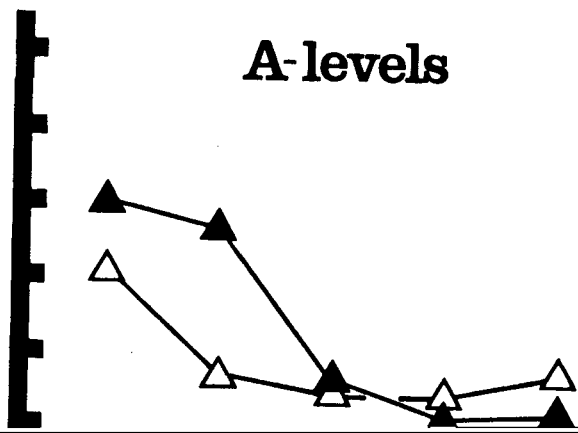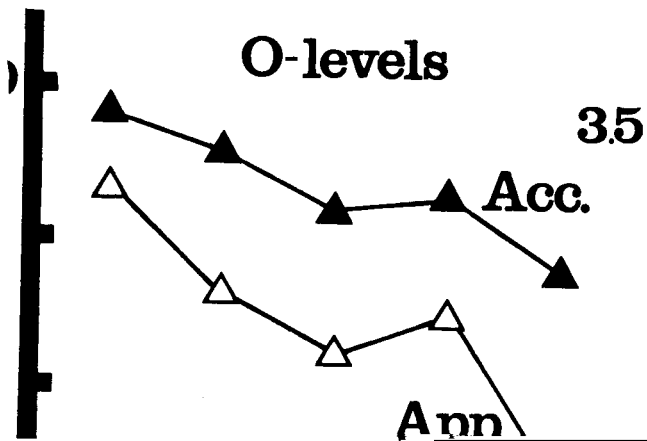
Figure 3-3: As for figure 3-2 except that the variables are the six demographic factors described in the text.

Non UK   45 Female
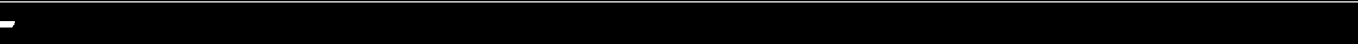
Figure 2.4.

the four descriptions of school type, as described in the

text.

Private sector ed'n

900

600

Total school size

Sixth form size

70

60

50

N to university

OC SM L EW SNI

OC SM L EW SNI

14f
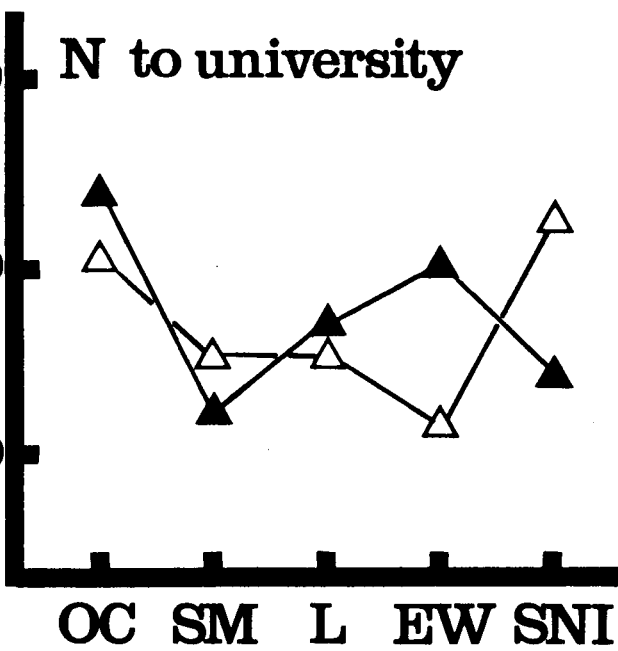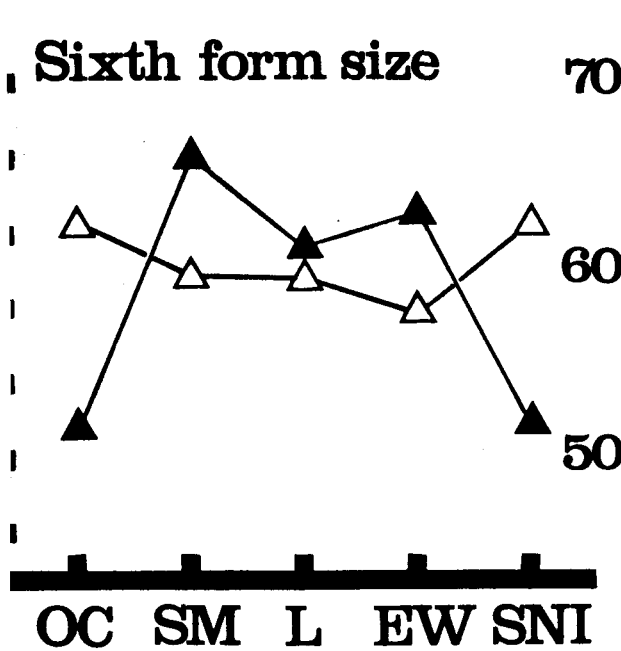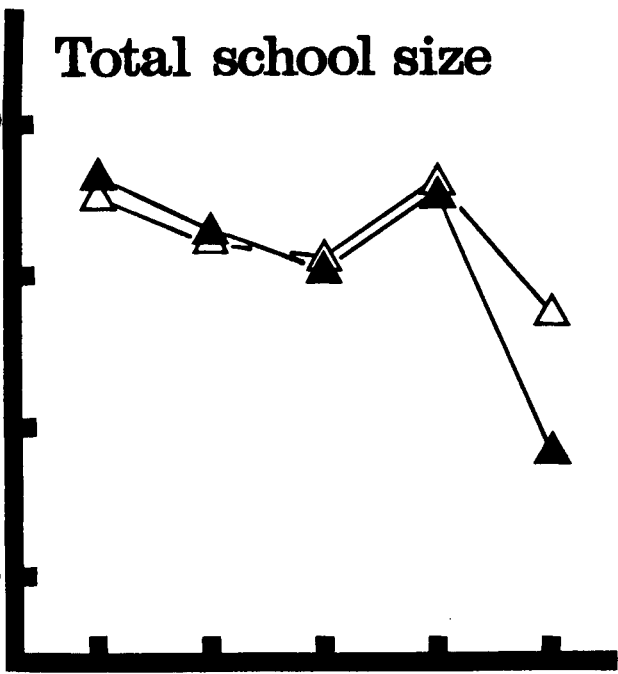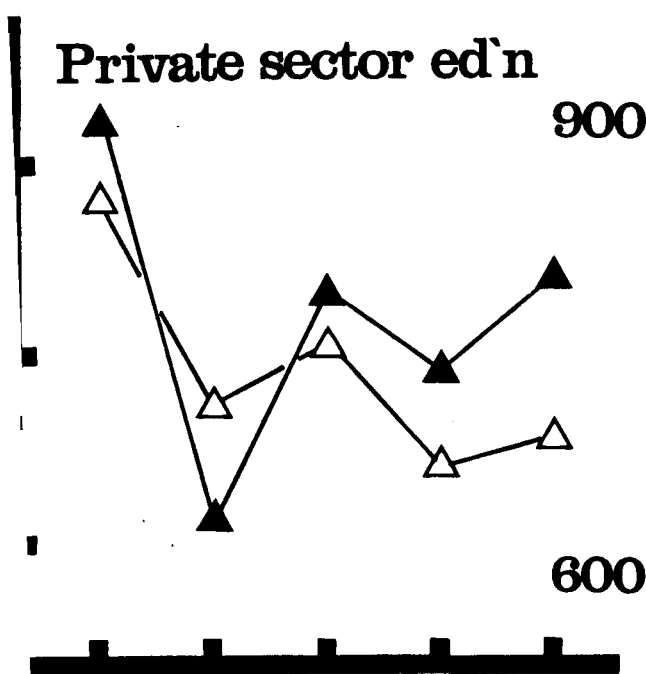
Figure 3-5: As for figure 3-2 except that the variables are
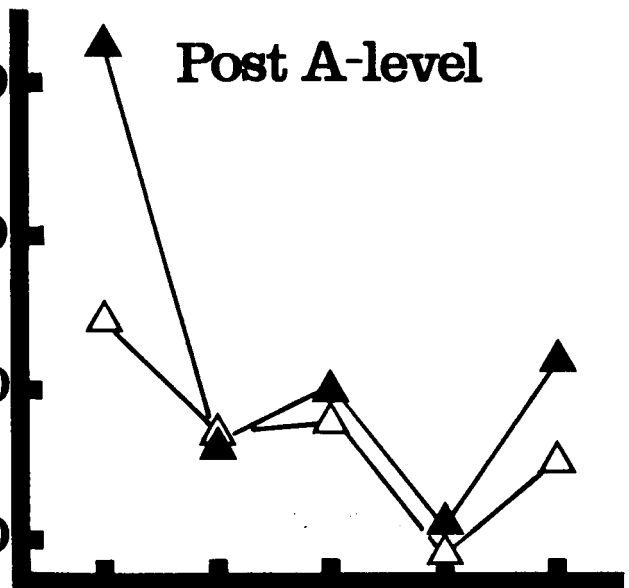the six UCCA form variables as described in the text.
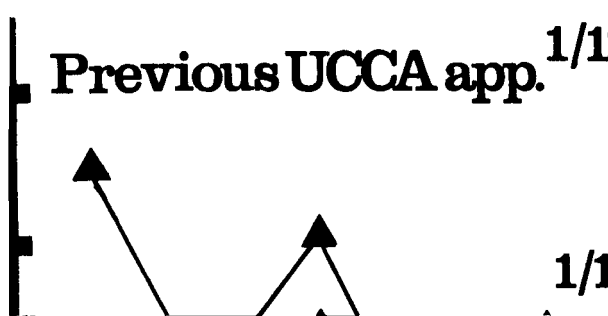
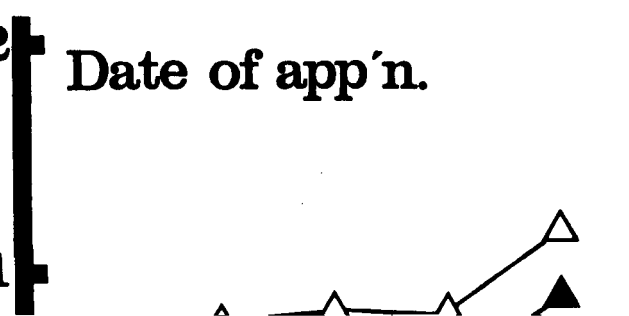## Oxbridge app's
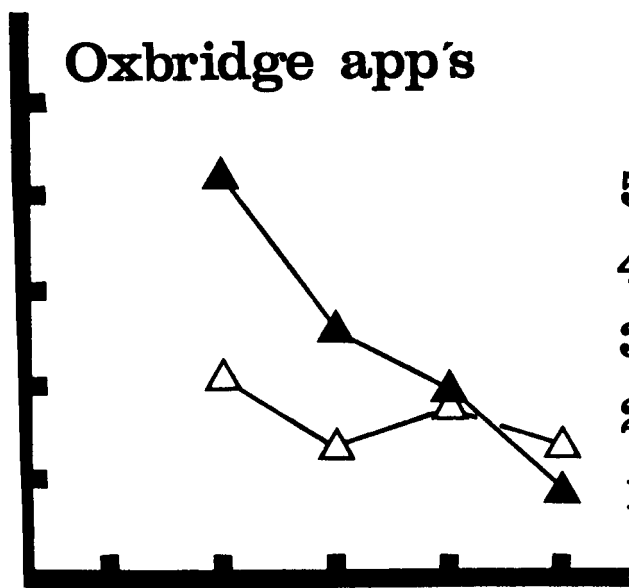
N London app's
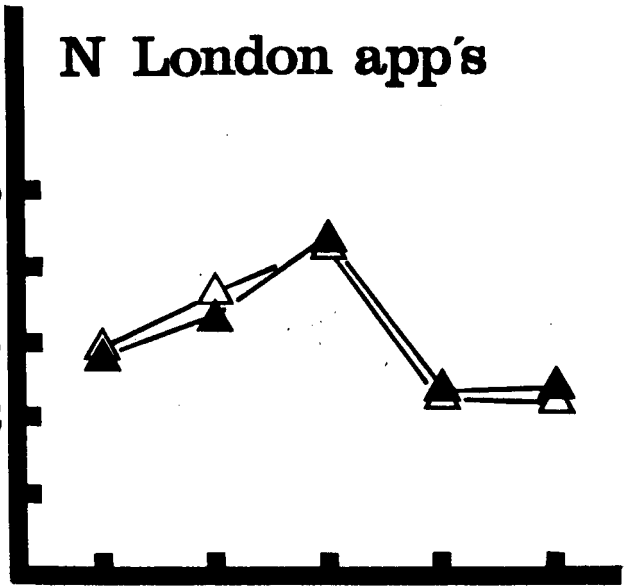
Brackets on form
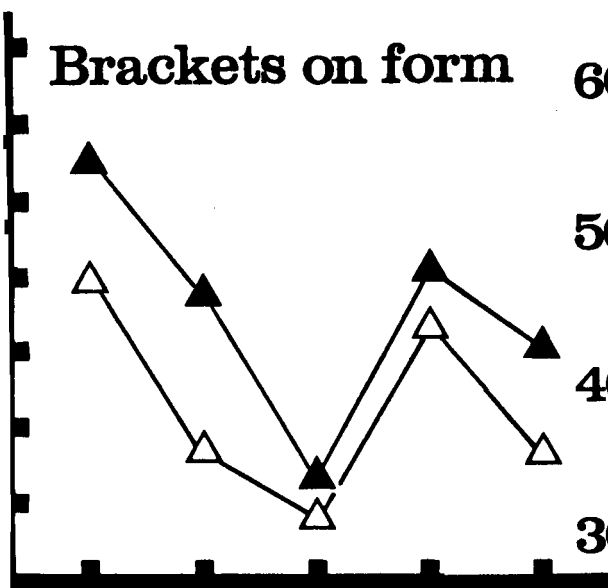
Post A-level

Previous UCCA app. 1/12

Date of app'n.

Figure 3-6: Shows a causal model of influences upon Q_w and

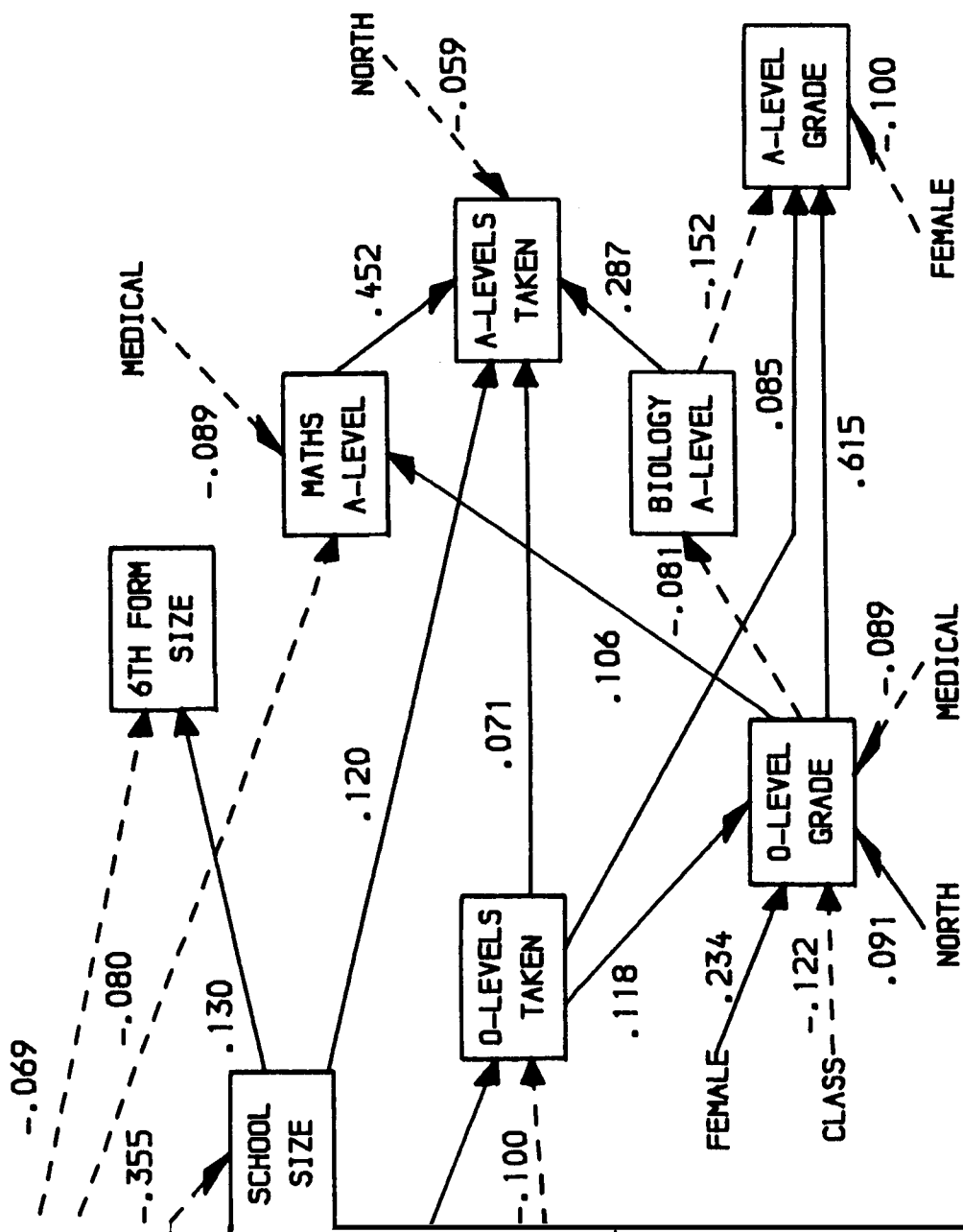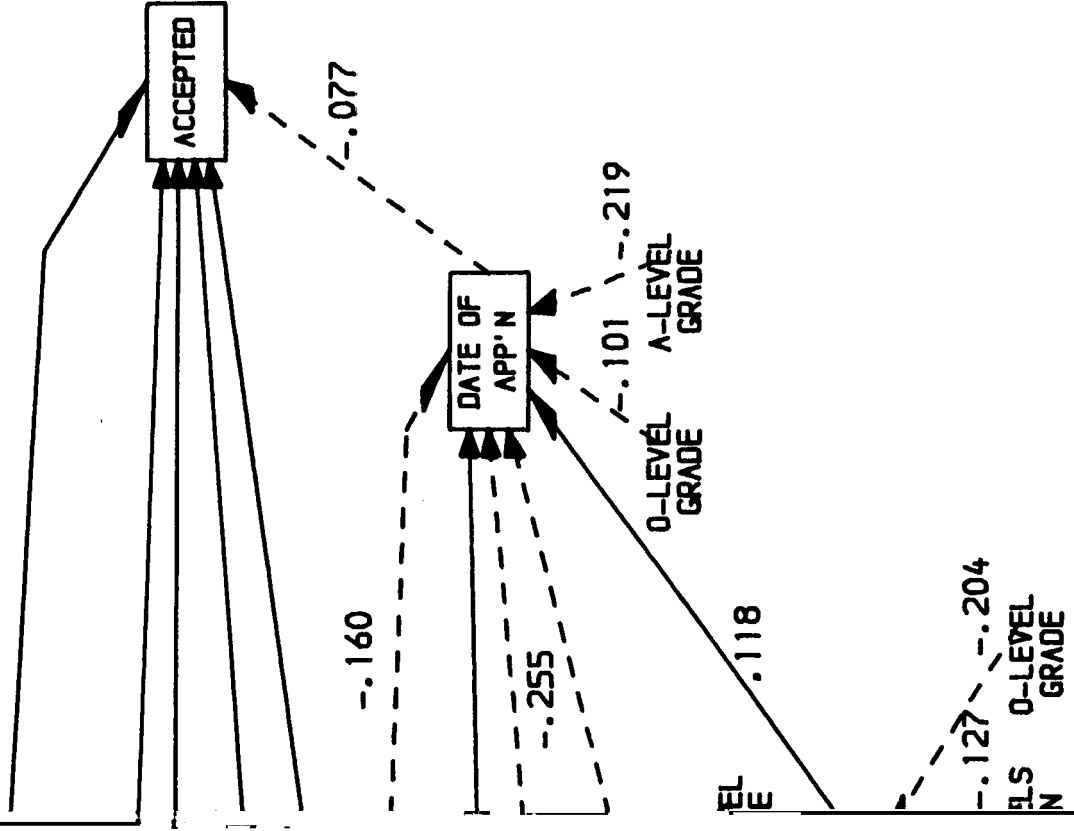significant at the 5% level. Values above the arrows

Figure 3-7: Shows the six significant proximate determinants

date of UCCA application are also shown, as are determinants

of those factors. Determinants of academic achievement are

shown in figure 3-6. Conventions are as for figure 3-6.

Note that earlier UCCA applications are coded by smaller

values, and hence negative influences indicate earlier

medical school applications on UCCA form: "Oxbridge app'n";

ACCEPTED

−.077

DATE OF
APP'N

−.101

−.219

A-LEVEL
GRADE

O-LEVEL
GRADE

−.160

.255

.118

−.127

−.204

O-LEVEL
GRADE

EL
E

LS
N

sig
diff

***
***
***
***
ns
***
ns
ns
–
*
–
–
ns
–
–
–
–
–
+
ns
–
ns
ns
ns
***
–

Table 3-2: shows, for UK nationals only, the numbers who were

Accepted   Rejected   Accepted

Table 3-3:   shows, for UK nationals only, the numbers who were
accepted or rejected for St. Mary's, by social class.
Chi-squared= 2.20, 4 df, p=.698;
linear trend Chi-squared=0.007, 1df, NS.

	Accepted	Rejected	%accepted
I	32	438	6.8%
II	27	317	7.8%
III	11	115	8.7%
IV	1	19	5.0%
V	0	17	0.0%