PART I

INTRODUCTION

The importance of the problem of admissions to universities has been repeatedly stressed by the successive commissions on Education in India. The University Education Commission (1948 - 49) reads-

'The problem of selecting students for higher studies and of intelligent counselling in the choice of their fields of study is of vital importance and should be tackled in a scientific way. With rapidly growing numbers of those receiving education, and with the inevitable diversification of high school education, the importance of this problem will ceaselessly grow. The universities will perform a service of national significance in applying themselves to its solution in right earnest.'

Again, in no less stringent terms, the Education Commission (1964 - 66) emphasized the need for selective admissions, when it said-

'If the present rate of expansion (at 10 percent per year) is assumed to continue for the next 20 years,

the total enrolments in higher education would be between

seven and eight millions by 1985-86 or more than twice

the estimated requirement of manpower for national deve-

lopment. An economy like ours can neither have funds to

expand higher education on this scale nor the capacity

to find suitable employment for the millions of graduates

who would come annually out of the educational system at

this level of enrolment. There is no escape but to link

broadly the total enrolments in higher education by ado-

pting a system of selective admissions .

Restricting the university admissions for a parti-

cular course implies that only those who have capacity

to complete the course successfully should be admitted

to the course. This poses very critical problems in the

field of academic prediction for two reasons- (i) that

the measurement and evaluation of complex higher mental

processes is not so simple, (ii) the want of appropriate

methods for using the complex measure.

Therefore, the selection of right persons and the

rejection of wrong ones, for a course, necessiate in the

first place (i) a qualifying test of high degree of relia-

bility and validity and secondly (ii) the most accurate

statistical methods for making academic prediction.

Consistent with these requirements, two kinds of pro-
blems arise- (i) problems of measurement and evaluation
of the required abilities or of measuring instruments in
education and (ii) problems of proper choice of stati-
stical methods for using the given instrument, in other
words problemsof Educational Statistics. As the title
of this thesis suggests, the present work deals with the
problems of second type.

REVIEW OF LITERATURE

The problem of selecting college students is recogni-
zed in other countries also and many investigators have
worked, in the realm of academic prediction, to bring
improvement in it.

Lincoln, in 1917 studied systematically the academic
prediction of freshman college achievement for 253 Harvard
students on the basis of high school performance, and
found a correlation of +.69. Jordan in 1922, also studied
the relationship of high school senior grades and college
freshmen grades, in the university of Arkansas and found
a correlation of +.50.

By this time, when the group tests of intelligence
were being newly developed and used for selection of army

personnel, the researchers experimented with these tests for academic prediction also.

Anderson (1920), used one of the newly developed tests such as Army Alpha test and found a correlation of +.38 between first-semester grades and Army Alpha scores for 373 Yale freshmen. Similarly in 1920, Jordan studied the relationship between Army Alpha scores and freshman grades for 485 students at the university of Arkansas and reported a correlation of .49.

With the increasing evidence as to their predictive value for academic purpose, the preparation of tests and their standardization flourished in 1920's, and many standardized tests came into being. Some investigators were now interested in knowing the relative predictive value of high school grade versus aptitute scores; they started comparative studies using them. Achievement tests were also included in some studies for comparison.

One such early attempt was made by Odell in 1927. The investigator attempted the prediction of success at freshman year at college, using high school marks and tests of intelligence, and found that high school marks are the single best predictor of college success.

Segel (1934) reported a number of such studies on the prediction of general college scholarship in which average high school marks and psychological tests were used. The range of correlations cited in his report, was from +.29 to +.69 for high school marks, and from +.35 to .54 for most of the mental tests.

Like Segel, Travers (1949), reviewed more than two hundred studies in which high school grades, aptitude tests and achievement tests were surveyed for their predictive values. The investigator concluded that average high school grades are superior to either subject matter tests or psychological tests as predictors of college grades.

Fishman (1957), in College Board Report, cites fifteen correlations between high school marks and average freshman grades. The correlations ranged from +.30 to .59, with a median of +.41. Lateron, in the 'supplement to College Board Scores', he cites correlations between Scholastic Aptitude Tests Scores and first-term college grades. The correlations ranged from +.14 to +.57 with a median of +.35.

After 1930, researchers were convinced that in
spite of inter-school variability in assessment of
grades, high school grades serve as the best predictor
of college achievement singly, and better results could
be achieved by adjusting the high school grades with the
help of standardized tests or using them in combination.
Further attempts 'to improve academic prediction were
based on this realization.

One of the early attempts to improve prediction of
college success from high school grades, in which inter-
school differences were taken into account, was by making
use of previous experience records. Chauncey and Freder-
iksen (1951) reported such experiments at Princeton and
Yale universities. Studies have been made of students
from every school sending a large number of students to
these universities. The achievements of these students
coming from different schools were noted, and correlations
in the grades were made accordingly. They reported that
grades corrected for a specific school or type of school
correlated with freshman grades at the +.60 level. The
method is,however, costly and hence has received limited
applicability in practice.

Another approach to improve prediction of college
performance was by way of making use of test data for
adjustment. Toops (1933) gave a method of transmutation
of marks, to correct for differences in the intelligence
levels of sub-groups of student population. In order to
effect this, Toops made use of regression technique.
Toop's method is the same as the Aptitude Method given
by Bloom and Peters (1961). They found that school gra-
des corrected by this method yield higher correlation.
Reitz (1934) also made use of scholastic aptitude scores,
to adjust grades of entrants to the university of Chicago,
and found that these adjustments improved the prediction
of college grades.

Similar attempts were made in Great Britain, too.
McClelland and his associates (1942) investigated, in a
survey for selection of secondary school students, rela-
tive predictive values of intelligence and scholastic
tests, teacher's estimates and ordinary qualifying exami-
nations and the combination of these measures for sele-
cting pupils for secondary courses. The investigators
transformed teachers' marks on the basis of the mean and
standard deviation of scores made by the pupils of the

various schools on a uniform test in the same subject.
An achievement test was used for assessing the relative
standing of each school, and then marks were adjusted.
Barn and McClelland, as also Yates and Pidgeon (1957)
lateron, found that teachers' marks, scaled by the
above method, give better results.

In majority of early prediction studies we thus
observe that investigators have confined in finding which
one of the predictors - high school grade, aptitude test
and achievement test gives better prediction in terms of
correlations and refinement of the mental tests, and thus
largely concerned themselves with the problems in 'Edu-
cational Measurement'. Lateron as they found that high
school grades serve as the best single predictor of co-
llege success, attempts were made to improve academic
prediction by adjusting grades to a uniform scale or
standard. The present work attempts to obtain further
evidence as to how much improvement takes place in aca-
demic prediction after this has been achieved, i.e.
after having a homogeneous data on a uniform scale, if
different statistical methods are used.

One more approach to the prediction problem, to be noted here is by taking into consideration the changing individual capacities at various levels of intelligence and differential aptitudes and the changing demands of syllabus. In such situation, the function to be used for prediction cannot be assumed necessarily linear.

Fishman (1960), in his presentation of a class of inter-related models to be used for prediction, did consider a distinct case when the change in school-to-college transition is not linear. Bloom (1961), who studied academic prediction scales using linear techniques recommended to experiment with non-linear techniques for further work. The analysis is rather simple with univariate case, but with multiple variables and different models, the work becomes complicated. Discussing the problems of studying non-linear relationships and possibilities of such relationships which are numerically large, Travers (1958) has pointed out the need for studies that search for a few expected relationships, and then, as he says, curvilinear relationships may perhaps be found.

It is therefore the main object of this thesis to
investigate how adequately linear and non-linear poly-
nomial functions can be used for the prediction of co-
llege success and simultaneously to study the scope, if
any, for further improvement in academic prediction.
The approach to the problem is empirical and rests on
the conviction that the academic success of students
largely depends on their scholastic abilities.

The two essential abilities (or factors or fun-
ctions as they are called) of college achievement are:
(1) verbal, that is of Language and (2) Mathematics.
The works of Thurstone, Cyril Burt, P.E. Vernon and
others have shown evidence of these two important abili-
ties by the factor analysis of test scores and examina-
tion marks. For the data under study, the predominance
of the same two factors was confirmed by Prof. T. P. Lele
and others. (Research Monograph 3, Examination Reform
and Research Unit, M.S. University of Baroda.)

Data

The data used in this thesis refer to the Secondary
School Certificate Examination (SSCE) of the former

Bombay State of the year 1957 and the Preparatory Science Examination (PScE) of the M. S. University of Baroda, 1958. The data of marks was obtained on a sample of 278 students, who were uniformly examined in the above mentioned examinations in the same subject and in the same year. This data was particularly used in this study because from the preliminary analysis, it was found that the marks satisfied certain conditions of good examination. The data exhibited a fairly high degree of reliability and validity, reaching the upper limit of .70 or more, in terms of correlation. It was thought proper under these conditions to go further and search for underlying mathematical relationships.

As mentioned earlier, the two important factors on which college achievement depends are: (1) Language and (2) Mathematics. The following factor analysis of the data under study elucidate this.

Factor Analysis

| Variable | Centroid Factor Matrix | | Rotated Factor Matrix | |
	I General	II Bipolar	I Verbal	II Numerical Sci- entific
1 SSCE English	.67	-.31	.74	.01
2 SSCE Language(Regional)	.57	-.30	.64	-.02
3 SSCE Science	.57	.16	.44	.39
4 SSCE Mathematics	.60	.40	.37	.62
5 PScE English	.84	-.37	.91	.03
6 PScE Lang.(Regional)	.69	-.24	.72	.08
7 PScE Science	.86	.21	.68	.56
8 PScE Mathematics	.74	.43	.48	.70

High factor saturations on the English tests in the first verbal factor and on mathematics tests in the second numerical factor clearly show the significance of English and Mathematics in the prediction of college marks.

Predictors

Consistent with the above factor analysis the marks in (i) SSCE English and (ii) SSCE Mathematics were used as predictors in the beginning for this study. As these marks have been comparable to standardized reliable and

valid achievement tests, they are referred to as SSCE
achievement tests. Afterwards study was also made using
SSCE General Science, as an additional predictor.

Criteria

The dependentt variable to be predicted is called
the criterion variable or simply 'criterion'. The main
criterion for which the mathematical function is to be
investigated is the overall degree of success at Prepa-
ratory Science Examination in question. Before arriving
at some expected relationship for this composite criterion,
it was decided to make, first, the analytic study of
the individual criterion variables forming the compo-
site.

The PSc examination total marks are composed of
three main subjects:

    1) English language   (200 marks)

    2) Mathematics   (100 marks)

    3) Science (physics, chemistry, biology, 450 marks)

These three serve as the individual criterion va-
riables and the prediction of each is studied individually

in the first three chapters. The prediction of overall
degree of success i.e. PScE Grand Total Percent is dealt
with in the fourth chapter.

Moreover, two types of tests that are used in aca-
demic prediction are: (1) Achievement tests and (2)
Aptitude tests. Whereas in India, admissions are given
on the basis of marks in SSCE, which is more like achieve-
ment type in chapter, in countries like United States,
many college and universities administer aptitude tests
for admission purposes. Therefore, in the first part,
the study is also made using standardized test scores
in English and Mathematics as predictors, the detailed
descriptions of which are given at appropriate places.

For convenience, the present work is divided into two
parts, viz. Part I and Part II. Part I covers chapters
I to IV and deals with non-linear polynomial regression
analyses for predicting the degree of college success, while
Part II covers chapters V to VIII and deals with discrimi-
nant analyses for prediction of pass-fail dichotomy of
college success. The statistical methodology is presen-
ted as explicitly as possible and the results are tabulated.
Graphs are also supplemented at some places.

Chapter I deals with the prediction of college achievement in the language of the medium of instruction at the M.S. University of Baroda, which is English.

Chapter II deals with the prediction of college achievement in Mathematics.

Chapter III deals with the differential prediction of the three criterion variables of college performance-PSc Science, Mathematics and English.

Chapter IV deals with the prediction of overall degree of college success.

Chapter V deals with the Linear Discriminant Function for predicting the dichotomy of pass-fail at College.

Chapter VI deals with the prediction of college success, by Linear discriminant analysis using an extra aptitude score for prediction.

Chapter VII deals with the Quadratic Discriminant Function for predicting the college success.

Chapter VIII deals with the academic prediction problem in general, summary of results and discussion, conclusions and suggestions.