ABSTRACT OF THESIS

PREDICTION OF SUCCESS IN THE DIVISION OF FORESTRY, COLORADO AGRICULTURAL AND MECHANICAL COLLEGE

Submitted by

John C. Clevenger

In partial fulfillment of the requirements

for the Degree of Master of Education

Colorado

Agricultural and Mechanical College

Fort Collins, Colorado

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ABSTRACT

The problem of predicting success for the student who desires to enter the Forestry Division at Colorado Agricultural and Mechanical College has become particularly important in these first few years following the close of World War II. The profession of forestry has been attractive to an unprecedented number of young men. As a result, all schools of forestry have been besieged by unusually large groups of students seeking admittance.

If counselors can increase their knowledge of the reliability and validity of prognostic data available, they can make more consistent interpretations which will result in greater efficiency in identifying those students who will fail.

The problem

The problem, then, is, How can the test score and high school rank data made available to advisers be used most effectively in counseling students who have stated a preference for entering training in the Division of Forestry at Colorado Agricultural and Mechanical College?

Analysis of the problem.--1. What is the relationship between grades achieved during the freshman year and graduation in the Division of Forestry, Colorado Agricultural and Mechanical College?

2. What is the relationship between scores obtained on the battery of tests administered to all new students and grades achieved during the freshman year for those freshman students desiring to enter the Division of Forestry at Colorado Agricultural and Mechanical College?

3. What is the relationship between rank in the high school graduating class and grades achieved during the freshman year for those students desiring to enter the Division of Forestry at Colorado Agricultural and Mechanical College?

4. What factors or combination of factors considered appear to be most useful in forecasting scholastic performance for those students interested in forestry?

5. What weights should be assigned to retained factors to secure best prediction of a student's scholastic performance?

6. How can these data be used most effectively by counselors at Colorado Agricultural and Mechanical College in counseling students who plan to seek entrance in the Division of Forestry?

Delimitation.--This study has been limited to the following:

1. Freshmen stating a preference for forestry who were admitted the first semesters, 1935 and 1936, and the fall quarters, 1945 and 1946.

2. The following tests: The American Council on Education Psychological Examination for College Freshmen, 1943 edition; the Iowa Placement Examination Chemistry Aptitude, Series CA-2, Form M; the American Council on Education Cooperative English Test, Form PM; the Nelson-Denny Reading Test for Colleges and Senior High Schools, Form A.

3. The data from students' records on file in the Registrar's Office and the Office of Student Affairs, Colorado Agricultural and Mechanical College.

The data were collected from the files of the offices of the Dean of Students and the college Registrar and included the following information:

1. The relative position of the student in his high school graduating class, commonly referred to as high school rank.

2. Raw scores made by the students on the American Council on Education Psychological Examination for High School Seniors and College Freshmen, 1943 edition, referred to here as the A.C.E.

3. Raw scores made by the students on the Cooperative English Test, Form PM, referred to here as the English test.

4. Raw scores made by the students on the Iowa Placement Examination, Series CAI, revised A, Chemistry Aptitude, to be referred to here as the Chemistry test.

5. Raw scores made by the students on the Nelson-Denny Reading Test for Colleges and Senior High Schools, Form A, to be referred to here as the Reading test.

6. Letter grades earned by students in college subjects and the number of quarter credits earned in these subjects by the students.

The high school rank was not available for all the students whose records are reviewed in this study. When recorded, the high school rank was expressed in terms of the quartile in which the student stood in his graduating class or as a statement of the student's relative position from the top of his graduating class and the number in his graduating class.

In order to facilitate comparison and analysis it was necessary to convert the high school rank of each student from a numerical standing to a percentage rank as follows:

1. The position of the student from the top of his class was subtracted from the number of students in the class to obtain the relative standing from the bottom of his graduating class.

2. The relative standing of the student in his class was divided by the number of students in the class and the resulting quotient was multiplied by 100.

In the case of students who were ranked by the quartile of the graduating class in which they stood, it

was necessary to use the mid-point of the quartile rank to indicate assigned percentage rank.

Sample studied

Freshman forestry students entering in the fall of 1935 and the fall of 1936 were studied in order to obtain data to select a critical freshman grade point average which would represent the lowest average a student might make in his freshman year and still graduate from the Forestry Division. These two classes were selected because they were able to complete the forestry course in four or five years of attendance before the start of World War II.

The September, 1935, freshman forestry class consisted of 97 students, while the 1936 class had 102 students.

Data on freshman forestry students entering in the fall of 1946 were studied to determine the relationship between data furnished advisers by the Office of Student Affairs and scholastic performance during the freshman year. By selecting every third name of students listed by alphabetical rank and then eliminating those who did not have complete scores or who did not establish a grade point average, a final total sample of 94 cases was obtained. Test score and high school rank data were available as follows for each variable in the sample.

1. English test scores 94
2. Chemistry test scores 94
3. Reading test scores. 94

4. A.C.E. test scores 94

5. H.S.R. 48

6. H.S.R., and A.C.E., English, Reading, and Chemistry test scores. . 48

In order to check on the predictive value of formulas derived from the study of the 1946 freshman class, data were studied on those freshman students entering in September, 1945, who expressed a desire to enter the Division of Forestry. There were 65 students in the September, 1945, freshman forestry class. Test score and high school rank data were available as follows for each variable in the sample.

1. English test scores. 49

2. Chemistry test scores. 49

3. Reading test scores. 49

4. A.C.E. test scores 49

5. H.S.R. 27

6. H.S.R., and A.C.E., English, Reading, and Chemistry test scores. . . 27

Findings and conclusion

Raw data were gathered on 94 students enrolling in September, 1946, who indicated a preference for forestry training. The data consisted of scores on six variables as follows:

1. Freshman year grade point average . variable 1

2. American Council on Education Psychological Examination . . . . . variable 2

3. Cooperative English test, Form P.M. . variable 3
4. Iowa Placement test, Chemistry Aptitude . . . . . variable 4
5. Nelson-Denny Reading test . . . . . variable 5
6. High school rank. . . . . variable 6

Zero-order coefficients of correlation between each variable and first-year grade point average were as follows:

1. $r_{12} = .618$
2. $r_{13} = .637$
3. $r_{14} = .496$
4. $r_{15} = .547$
5. $r_{16} = .521$

The best single predictor of freshman grade point average for pre-forestry students was the English test, followed by the A.C.E., the Reading test, high school rank, and the Chemistry test. Intercorrelations showed that the A.C.E., English, and Reading tests tend to measure common factors.

Multiple coefficients of correlation were computed between combinations of variables in order to determine a combination that would give the most efficient prediction of success in forestry. The combinations producing the highest multiple correlations were as follows:

1. $r_{1.246} = .762$
2. $r_{1.234} = .756$
3. $r_{1.34} = .721$
4. $r_{1.24} = .720$

When the Chemistry test was removed from the combination of variables there was a significant drop in the multiple coefficient of correlation.

The combination of the English and Chemistry tests and grade point average was the most practical combination to use in counseling. Addition of other variables did not increase the multiple correlation sufficiently to justify the additional time and effort involved.

Using the English raw score as x2 and the Chemistry raw score as x3 the following regression equation was computed:

$$W = .009_{x2} + .008_{x3} + .584$$

The regression equation applied to the 1945 sample resulted in predicting that seven students would achieve freshman-year grade point averages of less than 1.75. All seven students achieved less than a 1.75 average their freshman year. This was 100 per cent predictive efficiency for this segment of the sample population.

A study of 173 freshman students entering the Forestry Division in September, 1935, and 1936, was made in order to develop a critical freshman grade point average. It was found that students achieving below a freshman year

grade point average of 2.00 had only one chance in 14 of graduating. Therefore, the critical grade point average of 2.00 was selected.

The regression equation and the standard error of estimate were used to develop a nomographic predictive chart. This chart predicts the most probable grade point average from raw scores on the English and Chemistry tests. By using the chart, advisers should be able to estimate the chances of the student's succeeding scholastically and the advisers should also be able to identify and refer for clinical counseling students who appear to have little chance of succeeding in forestry.

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T H E S I S

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I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY SUPERVISION BY JOHN C. CLEVENGER

ENTITLED PREDICTION OF SUCCESS IN THE DIVISION OF FORESTRY, COLORADO AGRICULTURAL AND MECHANICAL COLLEGE

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF EDUCATION

MAJORING IN GUIDANCE AND COUNSELING

CREDITS 6

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Permission to publish this thesis or any part of it must be obtained from the Dean of the Graduate School.

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Chapter I

INTRODUCTION

The problem of predicting success for the student who desires to enter the Forestry Division at Colorado Agricultural and Mechanical College has become particularly important in these first few years following the close of World War II. The profession of forestry has been attractive to an unprecedented number of young men. As a result, all schools of forestry have been besieged by unusually large groups of students seeking admittance.

The Division of Forestry at Colorado Agricultural and Mechanical College has been forced to place limitations upon enrollment, yet a great many more young men apply than can be accepted. Three hundred and ninety-nine men enrolled in forestry at Colorado Agricultural and Mechanical College in the fall of 1946, and of this group only 150 could be accepted for the sophomore year. This situation, in effect, placed a stigma upon all freshman forestry students who failed to be accepted for further work in the division. In some cases men from surrounding states made grades that exceeded the all-men's average yet failed to be accepted because of the keen competition for the places available. To avoid this situation all

freshmen entering in the fall quarter, 1947, desiring training in forestry were placed in the Science and Arts Division with the privilege of applying for forestry work at the end of their first year. Thus, if they failed to be accepted, there was little stigma attached for they could continue in the Science and Arts Division or transfer to some other division.

However, the fact remains that a great many who enroll the first year, and who wish to take forestry, cannot be accepted. The results are threefold: The first is waste of public funds; the second is waste of economic resources of the student and his family; and the third is the detrimental effect to the personal adjustment of the student who fails to make the goal he has set for himself.

For several years Colorado Agricultural and Mechanical College has followed a student counseling program which attempts to discover as early in their course as possible those students who may fail for any one of a number of reasons. Quite often those students who are failing will be able to benefit materially from counseling with the result sometimes being that they change successfully to a new major course of study more in line with their basic aptitudes, abilities, and interests.

Educators recognize that students experience varying degrees of difficulty in various college subjects. For instance, it is often found that students who experience

difficulty in physical sciences will perform successfully in subjects in the social sciences.

Counselors at Colorado Agricultural and Mechanical College are furnished data which will enable them to measure certain potentials of freshman students. Included in these data are the rank in high school graduating class and relative rank in their college class measured by percentile scores on a battery of aptitude tests administered to all freshmen during their first week in college.

If counselors can increase their knowledge of the reliability and validity of prognostic data available, they can make more consistent interpretations which will result in greater efficiency in identifying those students who will fail.

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3. The data from students' records on file in the Registrar's Office and the Office of Student Affairs, Colorado Agricultural and Mechanical College.

The study was restricted to limitations outlined above for the following reasons:

1. The freshman classes entering in 1935 and 1936 were the last classes whose members had the opportunity to complete their work before World War II

2. The freshman classes of 1945 and 1946 were the first post-war classes and were more representative of future classes than were war-time classes.

3. The information on test scores and high school rank for all entering freshmen is routinely provided to all counselors.

Chapter II

REVIEW OF THE LITERATURE

There is an abundance of studies reported in the literature which reviews investigations relating to predicting success in college. These studies deal with a fairly wide range of predictive criteria including high school grades, rank in high school graduating class, size of high school, out-of-school contacts, various psychological and aptitude examinations, measures of personal traits and characteristics, and college marks. From a review of the literature it would appear that a substantial percentage of theses in the fields of psychology, and guidance and counseling have dealt with predicting some type of performance--and much of that in predicting success in college.

A review of the literature available at the Colorado Agricultural and Mechanical College Library revealed only one study (18) which dealt specifically with the study of success in college forestry work. Many of the studies reported dealt with predicting success for an entire college freshman class or from a segment of the class with no regard for proposed major field of study. Others dealt with prediction in specific study fields

such as engineering, arts and languages, and so on. During the war years (1941-46) there were comparatively few studies reported as compared with the output during the 10 years preceding the war.

In setting the problem it should be pointed out that several writers stated the need for each college or university to find its own correlation between college marks and prognostic factors. Butsch (4) in a study conducted at Marquette University in 1939 showed this need quite clearly. He found the correlations for the schools of Business, Engineering, Journalism and Liberal Arts ranging so greatly that he concluded:

> . . . a particular section which furnishes the best single predictor for one college may be entirely negligible in its contribution for another. (4:420)

This review of literature will be summarized under the following headings:

General Aptitude Tests

General Achievement Tests

Personality Tests

High School Marks

Rank in High School Graduating Class

Combination of Variables

Other Variables.

General aptitude tests

Douglass (8), in 1931, made one of the first and most complete summaries of prediction studies on correlations found between college grades and various prognostic measures. He reported on the correlations between intelligence test scores and college marks found by 160 different investigators in the period from 1920 to 1930. They varied from an r of .17 for the Stanford Binet at Pennsylvania State College to an r of .65 for the Thorndike with first year mark at Columbia University. The median of these coefficients was .45.

Segel (34), in 1934, made a study predicting success in college for the United States Office of Education. In one summary of 100 studies he reported a median correlation of .44 between mental tests and college marks.

Wagner (38), in 1934, compiled a summary of studies similar to those quoted above. She found median correlations between college grades and six different tests as follows:

Test	r with mark
Army Alpha	.37
Otis Self-Administering	.43
Terman Intelligence Test	.39
College Entrance Examination Board	.41 - .55
Ohio State	.43 - .52
American Council on Education Psychological Examination	.17 - .81

Durflinger (12), in 1943, summarized 47 correlations reported since 1934 and pointed out that the median correlation of these has risen to .52. There is a significant difference between this median and those previously reported. He accounted for this higher median in part by pointing out that the newer intelligence tests, being designed primarily for college students, may measure more of the factors present in scholastic averages than did earlier tests.

Rigg (29), in 1939, studied seven different college graduating classes and found the following correlations between intelligence scores, achievement scores, and scholarship.

Intelligence and first semester scholarship $r = .52$

Intelligence and four-year scholarship $r = .43$

Achievement scores and four-year scholarship $r = .47$

Freeman and Johnson (18) at the University of Minnesota studied a number of variables for predicting first-year honor point ratio of students in Agriculture, Forestry, and Home Economics. The investigation was carried on over a period of four years from 1933 through 1936. During this time 10 different measures were tested. Of all the measures considered, the high school percentile rank, the Johnson Science Application Test, and the Co-operative Algebra Test were the predictive variables that proved to be consistently valuable.

One important fact revealed by the study was the necessity to develop separate predictive formulas for the divisions of Agriculture, Forestry, and Home Economics.

The following table showing correlations for Forestry students was taken from Freeman and Johnson.

Table 1.--COEFFICIENTS OF CORRELATION AND STANDARD PARTIAL REGRESSION COEFFICIENTS FOR THE PREDICTION OF ACHIEVEMENT OF FRESHMEN IN THE DIVISION OF AGRICULTURE, FORESTRY AND HOME ECONOMICS AND IN THE COLLEGE OF AGRICULTURE, FORESTRY, AND HOME ECONOMICS, 1936-37. (Table 5) (18:54)

Predictive Variables	r	Standard Partial Regression Coefficients: Four Independent Variables	Three Independent Variables	Two Independent Variables
DIVISION OF FORESTRY				
High school percentile rank	.50	.40	.34	.38
Johnson Science Application Test	.46	.25	.23	.31
Cooperative Algebra Test	.44	.27	.28	
College Aptitude Test	.06	.22		
Multiple correlation (R)		.6463	.6129	.5746
Number of cases (73)				

The above correlations gave association between variables and the first year honor point ratio. The multiple correlation of .613 for the Division of Forestry based upon the three independent variables of Johnson Science Application Test, high school percentile rank, and Cooperative Algebra Test appeared to be quite significant.

Gould (20) at Colorado State College in 1944 reported that the American Council on Education Psychological Examination was the best single predictor, the correlation being .63.

General achievement tests

Some of the studies reviewed showed that achievement examinations will give as good predictions of success in college as will intelligence tests. Condit (5) in 1929 in a study at Colorado State Teachers College found that "reliable achievement tests yields as good results for classification purposes as does a psychological examination." (5:335)

Williamson and Bordin (39) in a study at the University of Minnesota in 1938 reported that a battery of six cooperative achievement tests--General Mathematics for High Schools, English, Contemporary Affairs, Literary Acquaintance, and General Science--was superior to any one of three scholastic aptitude tests (the Ohio State, The A.C.E., the Minnesota College Aptitude) and nearly

equal to high school rank in predicting college scholarship.

The following table taken from Durflinger (12) summarized studies by five investigations on correlations between high school achievement tests and college grades.

Table 2.--SUMMARY OF CORRELATIONS BETWEEN HIGH SCHOOL ACHIEVEMENT TESTS AND COLLEGE GRADES REPORTED SINCE 1934. (12:72)

Investigator	Institution	Test	Criterion grades	r
Butsch	Marquette U.	Iowa H. S. Content	first sem.	.34, .41, .42, .47, .47, .47, .47, .48, .48, .48, .53, .55
Hanna	Washington Sq. College	Coop.tests of math., Eng., and for. language	first sem.	.49
Landry	Three Eastern Colleges	C.E.E.B. tests	first year	.57
Leaf	LaSalle Jr. College	Iowa H. S. Content	first year	.63
Morris	Teachers college	Regents averages	first sem.	.39, .42, .48, .53
				median - .475

Douglass (8), Segel (34), Wagner (38), and Durflinger (12) compiled summaries of studies reporting correlations between general achievement examinations and

college scholarship. The following report of all four summaries was taken from Durflinger (12).

Table 3.--SUMMARIES OF CORRELATIONS BETWEEN CONTENT EXAMINATIONS AND COLLEGE SCHOLARSHIP. (12:73)

Author	Date	Number	Median or mean
H. R. Douglass	1931	67	.55 - Med. .54 - Mean
David Segel	1934	13	.545 - Med.
Mazie E. Wagner	1934	88	.56 - Med.
G. W. Durflinger	1942	20	.475 - Med.

Durflinger (12) accounted for this variation in median correlations as follows:

> 1. The number of studies summarized in the present study is so small that the difference between .55 and .475 is probably not significant.
>
> 2. There may actually be a tendency for the correlations between high school content tests and college grades to become smaller. High Schools are accepting more generally every year the principle that there is no significant correlation between the number of units earned in high school in any subject matter field and scholastic success in college. As a result students may not be prepared in one or two parts of the general high school achievement examination yet make good college students. As this principle achieves wider accpetance the correlation between comprehensive high school achievement tests and college grades will probably decrease. (12:73)

Personality tests

The measurement of personality traits as a predictor of college success has had relatively little

attention from investigators. Measurement of personality is a fairly new procedure. The service branches experimented with personality type tests in World War II with the hope of devising procedures that would provide for more efficient selection of a personnel for specific jobs.

St. Clair (32) writing in the Journal of Educational Psychology in 1939 stated that ". . . the conclusions of previous investigators that there was no linear relationship between personality traits and scholastic aptitude was substantiated." (32:301) Durea and Love (11), in 1939, found that scores from a personal traits inventory showed little relationship to academic standing.

Sherrick (35), in 1943, discussing psychological factors affecting selection of students for admission to college stated that long-range prediction of college success needs more reliable measures of less tangible variables such as emotional and social maladjustments. She also pointed out the need for additional study in the matter of "drives" and need for development of more adequate measures of motivation.

Ryans (31), in 1938, found persistence or drive to correlate more highly with college grades than any other personality factor. His study showed a correlation of .48 between college grades and the factor of persistence. Durflinger (12) reported a study by Turell at

Pasadena Junior College on the use of the Bernreuter Inventory. The following grade point ratios were used in calculating correlation coefficient:

1. General scholarship average for all subjects carried.
2. Average of academic subjects.
3. Average of semi-skill subjects.
4. Average of skill subjects.

Since he found no correlation coefficients higher than +0.12 and -0.15 he concluded,

> There seems to be no significant relationship between the factors which this inventory measures and the grades given by teachers, considered as a general average or by subject field. (12:75)

High school marks

A number of studies have been conducted on the value of high school marks as predictive indices. A review of these studies indicated that they will predict college scholarship as accurately as any other single factor. Douglass (8) said the best single type of prognostic data is the average high school mark. He found the average coefficient for high school marks and college marks to be .54, while it was only .44 between intelligence tests and high school marks. However, he did point out that the difference in high school marking systems was noticeable and made accuracy of prediction much more

difficult.

Adams (1) said that the student's quality of achievement during the freshman year in college is best predicted from his high school achievement.

Edds and McCall (14), in 1933, in considering various predictive criteria separately found that high school marks were .15 correlation points better than intelligence test scores and .21 points better than English test results in college prognosis. He stated that the regression equation showed that high school records should be weighted twice as much as intelligence test records and 10 times as much as English test results.

Durflinger (12) pointed out that correlations between high school and college scholarship will vary from .50 to .60 with a median of approximately .55 which is practically the same as a median of correlations reported between achievement tests and college scholarship. He concluded that it would be less laborious to accumulate the high school record than it would be to give a two-hour achievement test.

Rank in high school graduating class

Rank in the high school graduating class has been found by many investigators to be one of the best single prognostic criteria. Thurber (37), in 1933, found that correspondence between rank on secondary school

achievement and attainment for four years of college showed that 37 per cent of the Colgate students remained in the same quartile of the college class as they did in their high school class, 20 per cent advanced to higher rankings, 43 per cent fell to lower rankings, while 71 per cent were in the same quartile or a lower quartile. He found rank on the American Council of Education Psychological Examination obtained at the beginning of the freshman year less important as a predictive index of college achievement at Colgate than the rank of the student in his secondary school class.

Berg, Larson, and Gilbert (3), in 1940, compared a group of 79 liberal arts college freshmen who were in the lowest quarter of their high school graduating classes with 461 liberal arts college freshmen who were in the upper three fourths of their graduating classes. They found the lowest quarter group earned significantly lower grades than the regular group and that their performance on psychological tests was also significantly lower. They also found that the lowest quarter group was approximately one standard deviation below the mean of the regular group in grades and test scores. They reported that 22 students out of 79 scored below a critical level of 90 raw score on the A.C.E. and 395 composite score. Of these 22, 21 earned less than a "C" grade average. Emme (15), in 1942, in discussing seven

criteria for prediction of success stated that rank in high school graduating class seemed to be the best single criterion.

Ferguson (17), in 1933, studied 1,709 students at the University of Virginia and found the following in regard to High School rank.

Table 4.--RANK IN SCHOOL CLASS. (17:567)

Rank	Put on Dean's list of distinguished students	Passed 15 hours	Passed 12 hours	Passed 6 hours or less
Highest 10th	66	71	87	6
1st quarter	43	60	77	12
2nd quarter	19	34	54	29
3rd quarter	9	22	39	41
4th quarter	5	14	25	49

Requa (28) made a study of freshmen at Idaho Southern University in 1940 which showed a strong association between high school rank and college performance. She found that 77 per cent of the freshmen in the first quartile made grades averaging above the all-freshman average while only six per cent of the freshmen in the fourth quarter of the class made grades above the all-freshman average. Strang (36) found the relationship

between high school rank and success in college to be closer than the relationship between average high school marks and success in college.

McClanahan (25), in 1947, found a correlation of only .359 between first year grades and high school rank for freshman engineering students at Colorado Agricultural and Mechanical College. This was the poorest predictor of any of the five variables he studied.

Combination of variables

The literature revealed almost unanimous agreement that a combination of several variables is more accurate in predicting college scholarship than any single variable. In 1933, Edds and McCall (14), in a study of college freshman students at Milligan College found a correlation of $r = .81$ between a combination of high school marks, intelligence scores, English ability, and college marks. In 1930 Crawford (6) working at Yale University found a multiple correlation of .74 between college scholarship and a combination of College Entrance Examination Board Tests, high school record, Intelligence Test, and age at entrance.

Johnston and Williamson (22), in 1934, in early studies at the University of Minnesota showed that college scholarship could be predicted with a high degree of success from high school rank and a college

aptitude test score with the best predictions obtained by averaging the two. They used the abbreviation "C A R" to indicate college aptitude rating based on an adapted psychological test averaged with high school rank. Their results showed a very strong positive relationship between C A R percentiles and percentage of total students with degrees from the Arts College. These C A R ratings were originally used over a four-year period from 1928 to 1932 to assign 996 students to non-degree work and limitation of these students to certain subjects enabled them to secure higher scholarship standings. This program led to the establishment of the "General College" at the Universersity of Minnesota.

There would appear to be a limit to the number of variables that could be used in developing multiple correlations. Manning (26) found that a combination of a psychological test and an English test gave a good prediction and that adding high school rank as a third variable would hardly justify the extra trouble involved.

Segel (34), Douglass (8), and Wagner (38) have reported summaries of many such multiple correlations. Durflinger (12) made a summary of multiple correlations calculated after the Segel and Wagner summaries in 1934 and reached the following conclusions:

1. Multiple correlation coefficients are rarely higher than .80 regardless of variables used.

2. An intelligence test, a good achievement test, and high school grade averages together usually bring the highest miltiple rs.
3. The median multiple r as found in the summaries is between .60 and .70.

The following table was taken from Durflinger (12).

Table 5.--MULTIPLE CORRELATION COEFFICIENTS REPORTED BY DIFFERENT INVESTIGATORS SINCE 1934. (Table V)(12:77)

Prognostic variables	r	Reporter	Institution
H. S. rank, intelligence & h.s. content test	.59 .70	Butsch	Marquette U.
Elem. school I.Q. & 10th grade scholarship	.70	Byrns and Henmon	Wisconsin U.
T.C.P.A. intelligence, men elementary and English tests women	.54 .55	Durflinger	Nebraska Trs. Col.
T.C.P.A. intelligence, English and elementary tests.	.688	Heilman	Colo. St. Col. of Education
H. S. Marks, Ohio State Intelligence and study performance test	.75	Hartson	Oberlin
T.C.P.A. intelligence and elementary tests	.620	Heilman	Colo. St. Col. of Educ.
Intelligence and H. S. grades	.56	Hepner	San Diego State
Intelligence, English aptitude, H. S. content tests and H. S. marks	.79	Leaf	La Salle Jr. College
Intelligence, H. S. rank, College aptitude test and freshman English	.83	Root	Hamline U.

Table 5.--MULTIPLE CORRELATION COEFFICIENTS REPORTED BY DIFFERENT INVESTIGATORS SINCE 1934.--Continued.

Prognostic variables	r	Reporter	Institution
Reading, English, immediate recall and Beta-type tests	.70	Selover & Porter	Ohio U.

Other variables

Russell (30) stated that success in college depends more on certain factors other than those that can be measured by marks and tests. He named these other factors as motivation; physical and mental health; personal and social relationship of the student with parents, students, and faculty; on the degree which home and school have prepared students for independent living and self-direction.

Feder (16) at Iowa University in 1940 studied the size and type of high school and time lapse between high school graduation and college entrance as factors which affect achievement and its prediction at the college level. His study revealed the following:

. . . . . .

2. Students from the larger and out-of-state high schools were best equipped for college in terms of their status on the Freshman Qualifying Examinations;

3. Graduates of parochial schools were the poorest college risks in terms of ability and showed poorest achievement;

4. Out-of-state students did not achieve in keeping with their superior ability;

. . . . . .

8. The students coming directly from high school seemed to have best preparation for college as measured by the Qualifying Examination;

. . . . . .

11. Mortality was lowest among students who came directly to college from high school. (16:117)

Dwyer (13), in 1938, studied 1,222 students at the University of Michigan to determine the relationship existing between size of high school attended and success in college. He found:

1. A positive correlation coefficient of high school size with first semester record of not more than .25.

2. Correlation coefficient between high school size and scholastic record decreases as student progresses through college and becomes insignificant by the end of 2 or 3 years.

3. A larger percentage elimination of students from small schools than of students from large schools in the first and immediately following semesters.

4. The relative scholastic equivalence of all groups in the later college years. (13:279)

Alexander and Woodruff (2) made a very interesting study of the 1938-39 freshman class at the University of New Hampshire. They found a strong relationship between scholastic record in college and social development. Seventy-eight per cent of those in the highest academic group fell in the higher social development

groups and none placed in the lower groups. Only four per cent of the lowest academic group ranked in the two higher groups on social development. Their study suggests that proposals and policies devised to improve academic work by seriously curtailing a student's athletics, employment, and social activities are of minor importance. They also found that student organizations and activities command a greater share of the time and interest of students of high indicated abilities. Furthermore, their study stated that few college students with high high-school marks placed in the lower classification in social development.

Darley (7) considered various criteria in a study of clinical prediction in professional training. He was one of the few investigators to consider patterns of high school subjects and found that they are less valid as indices of college achievement than high school achievement and basic measured ability.

Using the results of predictive studies

Regression equations developed by statistical treatment of the variables considered have been used by various investigators to predict college grades.

In discussing the value of predictive measures, Freeman and Johnson (18) stated:

> In a fairly large majority of cases predictions (in individual cases) based on these measures (correlations based on groups of

students) will be reasonably accurate. The remainder will fail in various degrees to afford a true picture of subsequent performances. This is especially important in the middle ranks of the prediction distribution, for prediction of complete failure or signal success are comparatively more dependable (18:35)

Douglass and Maaske (9) in 1942 stated:

Regression equations using certain variables as applied to one group can be used in predicting the degree of scholastic success for a new group only if the hypothesis that the two groups are similar in general ability and preparation is well founded. (9:34)

Following a study conducted over a three-year period Douglass and Maaske (9) concluded:

Barring radical changes. . . the group entering each succeeding year can apparently be considered as a homogeneous sample from the same population group with respect to general aptitude or scholastic achievement (9:35)

Williamson and Bordin (39) in 1942 suggested that the following limitation should be considered:

1. Grades are not always perfectly reliable and neither can they always be considered a valid criterion of success.

2. The most reliable criteria will not yield coefficients of unity because (a) success comes not only from possession of required aptitudes but also from skillful and persistent use of those aptitudes, and (b) too often results of studies are applied to one person with little regard for the differences between the individual and the group.

Williamson and Bordin (39) further stated:

> Generalized regression equations do not make proper allowances for individual factors except by means of the factor of group probability. . . group statistics are indispensable and yield a more reliable and valid criterion than anecdotal instances of chance association . . . . (39:4)

Summary

The review of literature reported herein produces evidence to support the following conclusions:

1. General aptitude tests, general achievement tests, personality tests, high school marks, and rank in graduating class tend to correlate positively with college grades.

2. Combination of these variables tends to result in higher correlations with grades than when single variables are considered.

3. There is sufficient tendency for these variables to differ in predictive value in different colleges, or even within the major divisions of one college, to support the necessity for each college to study the variables in the light of its own situation.

4. Prediction of complete failure or outstanding success is comparatively much more dependable than predictions in the middle ranks of the group under study.

5. Regression equations may be used to

predict college grades provided subsequent groups are similar in general aptitude and scholastic achievement. It is generally assumed that succeeding groups come from a homogeneous sample.

Chapter III

METHODS AND MATERIALS

For determining the relationship between predictive data and scholastic performance in the Division of Forestry, Colorado Agricultural and Mechanical College, data were studied on the four freshman classes entering in September, 1935; September, 1936; September, 1945; and September, 1946. The Office of the Registrar at the college provided grade point averages and total time in school for those students who entered in September, 1935, and September, 1936. Records in the Office of Student Affairs provided necessary data on those freshman forestry students who entered in September, 1945, and September, 1946. These data from the Office of Student Affairs are routinely furnished to all freshman and sophomore advisers and include the following information:

1. The relative position of the student in his high school graduating class, commonly referred to as high school rank.

2. Raw scores made by the students on the American Council on Education Psychological Examination for High School Seniors and College Freshmen, 1943 edition, referred to here as the A.C.E.

3. Raw scores mde by the students on the Cooperative English Test, Form PM, referred to here as the English test.

4. Raw scores made by the students on the Iowa Placement Examination, Series CAI, revised A, Chemistry Aptitude, to be referred to here as the Chemistry test.

5. Raw scores made by the students on the Nelson-Denny Reading Test for Colleges and Senior High Schools, Form A, to be referred to here as the Reading test.

6. Letter grades earned by students in college subjects and the number of quarter credits earned in these subjects by the students.

The high school rank was not available for all the students whose records are reviewed in this study. When recorded, the high school rank was expressed in terms of the quartile in which the student stood in his graduating class or as a statement of the student's relative position from the top of his graduating class and the number in his graduating class.

In order to facilitate comparison and analysis it was necessary to convert the high school rank of each student from a numerical standing to a percentage rank as follows:

1. The position of the student from the top

of his class was subtracted from the number of students in the class to obtain the relative standing from the bottom of his graduating class.

2. The relative standing of the student in his class was divided by the number of students in the class and the resulting quotient was multiplied by 100.

In the case of students who were ranked by the quartile of the graduating class in which they stood, it was necessary to use the mid-point of the quartile rank to indicate assigned percentage rank.

Since the main emphasis in this study is placed on those students enrolling subsequent to World War II, time limitations made it necessary to consider the grade point average made by each student in his freshman year as the criterion of academic success for those students desiring to continue in forestry.

Grade point averages at Colorado Agricultural and Mechanical College are computed as follows:

1. Weights assigned each letter grade for computing quality points.

A = 4	E = 0
B = 3	WF = 0 (Withdrawal failing)
C = 2	WP = (Withdrawal passing)
D = 1	disregarded.
F = 0	

2. The grade point average for the freshman year was computed by dividing the total quality points earned during the year by the total number of credits.

For example, a student who completed his freshman year with five credit hours of A, 10 credit hours of B, and 20 credit hours of C would have a total of 90 quality points and 35 credits. Dividing quality points by credit hours gives an average of 2.57. Colorado Agricultural and Mechanical College students must maintain a quality point average of 2.00 or better to avoid probation status and eventual suspension.

Sample studied

Freshman forestry students entering in the fall of 1935 and the fall of 1936 were studied in order to obtain data to select a critical freshman grade point average which would represent the lowest average a student might make in his freshman year and still graduate from the forestry division. These two classes were selected because they were able to complete the forestry course in four or five years of attendance before the start of World War II.

The September, 1935, freshman forestry class consisted of 97 students, while the 1936 class had 102 students 1/.

1/ See Appendix A.

Data on freshman forestry students entering in the fall of 1946 were studied to determine the relationship between data furnished advisers by the Office of Student Affairs and scholastic performance during the freshman year. By selecting every third name of students listed by alphabetical rank and then eliminating those who did not have complete scores or who did not establish a grade point average a final total sample of 94 cases was obtained. Test score and high school rank data were available as follows for each variable in the sample 2/.

1. English test scores 94
2. Chemistry test scores 94
3. Reading test scores 94
4. A.C.E. test scores. 94
5. H.S.R. 48
6. H.S.R. and A.C.E., English, Reading, and Chemistry test scores. 48

In order to check on the predictive value of formulas derived from the study of the 1946 freshman class, data were studied on those freshman students entering in September, 1945, who expressed a desire to enter the division of forestry. There were 65 students in the September, 1945, freshman forestry class. Test

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2/ See Appendix B.

score and high school rank data were available as follows for each variable in the sample 3/.

1. English test scores 49
2. Chemistry test scores 49
3. Reading test scores 49
4. A.C.E. test scores. 49
5. H.S.R. 27
6. H.S.R. and A.C.E., English Reading, and Chemistry test scores. 27

3/ See Appendix C.

Chapter IV

ANALYSIS OF DATA

Raw data used in determining the effectiveness of test scores and high school rank in predicting success in forestry were obtained from the files in the Office of Student Affairs and from records in the Registrar's office, Colorado Agricultural and Mechanical College. These data consisted of raw scores achieved by freshman students on the battery of entrance examinations (the A.C.E., and the English, Chemistry, and Reading tests), grade point averages, and in some cases rank of the student in his high school graduating class.

Data were collected for the four classes entering the fall terms of 1935, 1936, 1945, and 1946. The data from the 1935 and 1936 classes were collected in order to determine a critical freshman grade point average for those students wishing to major in forestry. The 1946 sample was studied for the purpose of determining the relationship of first-year grade point average with test scores and high school rank. The 1945 sample was studied to test the predictive efficiency of a regression equation developed from a study of the 1946 sample.

The data used in this study were analyzed by

statistical methods in order to ascertain their relationship to success, as measured by first-year grade point average and graduation, and to develop a regression equation to predict grade point averages when the raw scores on the variables were known.

Statistical methods

Statistical methods used in analyzing the 1946 sample in order to determine the relationship between the variables and first-year grade point average are summarized as follows:

1. Zero-order correlations were computed to determine the relationship between each variable and first-year grade point average. The Pearson Product-Moment Method (19:265-71) was used in computing the zero-order correlations.

2. Inter-correlations between each variable and every other variable were computed to determine the degree to which the variables measured common factors.

3. Following the procedure outlined by Garrett (19:420-60), multiple correlation coefficients were computed from the inter-correlations obtained to determine the relationship between various combinations of variables and grade point averages.

4. A regression equation was developed for the purpose of weighting known factors (test scores) in predicting grade point average. The regression equation was computed by the method presented by Garrett (19:420-60).

5. The standard error of estimate was computed to determine the accuracy with which grade point averages could be predicted by use of the regression equation. The formula for standard error of estimate was taken from Garrett (19:300-1).

6. To provide quick estimates of the efficiency of various combinations of variables in predicting grade point average, the coefficient of forecasting efficiency (E) was determined for each multiple coefficient of correlation (19:345-6).

By use of the regression equation developed from the data on the 1946 sample, predicted grade point averages were computed for each member of the 1945 sample. A zero-order coefficient of correlation was developed in order to determine the relationship between achieved grades and predicted grades in this sample.

A nomographic predictive chart was developed from the regression equation in order to simplify predicting grade point average from known variables.

Zero-order coefficients of correlation

The Pearson Product-Moment Method (19:265-71) was used to compute the zero-order coefficients of correlation between first-year grade point average and each variable, and between each variable with each of the other variables, Table 6.

Table 6.--ZERO-ORDER COEFFICIENTS OF CORRELATION BETWEEN VARIABLES.

Variable*	Variable*					
	2	3	4	5	6	1
2	X	.701	.220	.717	.458	.618
3	X	X	.270	.701	.405	.637
4	X	X	X	.147	.359	.496
5	X	X	X	X	.355	.547
6	X	X	X	X	X	.521

*Variables:

1 First-year grade point average
2 A.C.E. test
3 English test
4 Chemistry test
5 Reading test
6 High school rank

The English test, r = .637 with grade point average, was the best single predictor. This was only slightly higher than the A.C.E. test which correlated .618 with grade point average. The Reading test was the third best predictor with a correlation of .547; high school rank

was fourth with .521; and Chemistry with a correlation of .496 was the lowest single predictor of grade point average.

Inter-correlations between the variables indicated that the English, Reading, and A.C.E. tests measured common factors to considerable degree, Table 6. The Chemistry test and high school rank had a relatively low correlation with the other variables, in addition to the lowest correlation with grade point average.

Multiple coefficients of correlation

A number of investigators, including Butsch (4), Durflinger (12), Johnston and Williamson (22), and McClanahan (25), have shown that multiple correlations using more than three variables with grade point average have added very little to increasing forecasting efficiency. Therefore, multiple correlations in this study were limited to combinations of two and three variables with grade point average.

The method recommended by Garrett (19:420-60) was used in calculating multiple correlations between combinations of the variables (the A.C.E. and the English, Chemistry, and Reading tests, and high school rank) with first-year grade point average.

Table 7 lists the multiple coefficients of correlation between various combinations of two variables with

grade point average.

Table 7.--MULTIPLE COEFFICIENTS OF CORRELATION BETWEEN COMBINATIONS OF TWO VARIABLES AND GRADE POINT AVERAGE.

Combined variables*	Variable*			
	3	4	5	6
r1.2x	.682	.720	.635	.674
r1.3x	X	.721	.652	.699
r1.4x	X	X	.713	.619
r1.5x	X	X	X	.650

*Variables:

1 First-year grade point average
2 A.C.E. test
3 English test
4 Chemistry test
5 Reading test
6 High school rank

The multiple coefficient of correlation between a combination of the English and Chemistry test scores with grade point average was .721, which was only very slightly higher than the next highest multiple correlation of .720 between the A.C.E. and Chemistry test scores with grade point average. A combination of the Chemistry and Reading test with grade point average was only slightly below the highest two combinations ($\underline{R}$1.34 and $\underline{R}$1.24) with an $\underline{R}$ of .713. A review of the table above shows that the Chemistry test added to any of the combinations substantially increases forecasting efficiency.

Table 8 lists the multiple coefficients of correlation between a combination of three variables with grade point average.

Table 8.--MULTIPLE COEFFICIENTS OF CORRELATION BETWEEN COMBINATIONS OF THREE VARIABLES AND GRADE POINT AVERAGE.

Combined variables*	Variable*		
	4	5	6
r1.23x	.756	.683	.691
r1.24x	X	.747	.762
r1.34x	X	.744	.749
r1.25x	X	X	.688
r1.35x	X	X	.708
r1.45x	X	X	.715

*Variables:

1	First-year grade point average	4	Chemistry test
2	A.C.E. test	5	Reading test
3	English test	6	High school rank

The multiple coefficient of correlation between a combination of the A.C.E. and Chemistry tests, high school rank with grade point average produced the best combination, the multiple correlation being .762. The combination of the A.C.E. and the English and Chemistry test was only slightly lower, the correlation being .756. The next best correlations from various combinations of variables were in a range from $\underline{R}$ = .744 to $\underline{R}$ = .749. When

the Chemistry test was dropped from the combination there was a significant drop in the correlation.

Coefficient of forecasting efficiency

The coefficient of forecasting efficiency, E, is useful in providing a quick estimate of the predictive efficiency of an obtained R. The forecasting efficiency of a combination of the A.C.E. and Chemistry tests and high school rank with grade point average was the highest of any of the combinations with an E of .353.

Table 9.--THE COEFFICIENT OF FORECASTING EFFICIENCY, E, FOR COMBINATIONS OF VARIABLES HAVING THE HIGHEST MULTIPLE COEFFICIENTS OF CORRELATION, R, WITH GRADE POINT AVERAGE.

Variables*	R	E
1, 2, and 4	.720	.306
1, 3, and 4	.721	.307
1, 3, 4, and 6	.749	.338
1, 2, 3, and 4	.756	.345
1, 2, 4, and 6	.762	.353

*Variables:

1 First-year grade point average
2 A.C.E. test
3 English test
4 Chemistry test
5 Reading test
6 High school rank

A combination of the English and Chemistry tests predicted grades with an E of .307 which was only four and six-tenths per cent less than the highest E of .353 made from the best combination of three variables with grade point average.

The formula, $E = 1 - \sqrt{1 - r^2}$, for computing the coefficient of forecasting efficiency is taken from Garrett (19;345).

The regression equation

A regression equation based on English (x2) and Chemistry (x3) test scores was developed to predict the first-year grade point average, W. Data for the equation were obtained from the September, 1946, group of freshmen indicating a desire to enter the Forestry Division at Colorado Agricultural and Mechanical College. The equation is as follows:

$$W = .009x_2 + .008x_3 + .584.$$

The standard error of estimate

The regression equation listed above was developed to predict grade point averages for pre-forestry freshman students when English and Chemistry test scores are known. The formula for standard error of estimate, $\sigma_{est} = \sigma_1 \sqrt{1 - r^2_{1.23}}$ (19:300-1), was used to find the probability of the predicted grade average equaling

achieved grade average. The symbol σ_1 represents the standard deviation of achieved grade point average distribution of the 1946 sample. Previously, this standard deviation had been determined to be .69. The symbol, $r^2_{1.23}$, represents the multiple coefficient of correlation between the English and Chemistry tests and grade point average. This correlation was previously reported as .721. Substituting these figures in the formula gave a standard error of estimate of .47.

The probability that the earned grade point average falls within the limits of .47 grade points above or below the predicted grade point average is 68 chances out of 100, according to Garrett (19;300).

Predictive efficiency of regression equation

The regression equation was applied to each case in the 1945 sample of freshman forestry students to investigate the relationship of predicted grade point average to achieved grade point average. A zero-order coefficient of correlation of .461 was obtained between predicted and achieved grades in the sample. At first the r of .461 might appear to be somewhat lower than normally would be expected. However, certain outstanding results of the comparison of predicted grades with achieved grades will be presented in the discussion chapter.

The standard error of estimate of predicted

grades for the 1946 sample was computed to be .47. This means that there are 68 chances out of 100 (19:300), that the predicted grade point average will fall within a range of .47 grade points above or below the achieved grade point average.

There were 49 students in the 1945 sample. From these, then, it might be normally expected that the regression equation would predict the grade point average of 32 students (68 per cent) to fall within the range of .47 grade points above or below the achieved grade point average. When achieved grades were compared with predicted grades, it was found that in only 24 cases were the predicted grades within the limits of one standard error of estimate. This represented only 49 per cent as compared with the expected 68 per cent.

In checking the scatter diagram 1/ of the predicted grade point averages plotted against achieved grade point averages it was found that 16 out of the 49 students in the 1945 sample fell within the upper left-hand quadrant of the scatter diagram. This meant that 32 per cent of the students in the sample failed to achieve grade point averages as high as those indicated by use of the regression equation. At the same time only four cases, or eight per cent, fell in the lower right-hand quadrant of

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1/ See Appendix D.

the scatter diagram indicating their achieved grades were higher than those predicted by application of the regression equation.

Prediction of critical grade point average

The samples of 1935 and 1936 freshman forestry students were studied in order to determine a critical or "cutting" point in the grade point average below which experience has shown first-year grade point to be indicative of probable failure to complete the work for a degree in the Forestry Division. A bivariate frequency distribution (Table 10) was developed from the sample to show the total time enrolled in college by students achieving various grade point averages. The table also shows the number of graduates in the various categories of the distribution. The table clearly indicates a strong positive relationship between freshman grades and eventual graduation. More students making high grades in their freshman year eventually graduated than did those students who made the minimum acceptable grade point average of 2.00. Students with an accumulative average of less than 2.00 in their freshman year had only one chance in 14 of graduating from the Forestry Division.

Table 10.--ASSOCIATION BETWEEN GRADES ACHIEVED DURING THE FRESHMAN YEAR IN THE DIVISION OF FORESTRY, COLORADO AGRICULTURAL AND MECHANICAL COLLEGE, BY STUDENTS ENTERING IN SEPTEMBER, 1935 AND 1936, TO TOTAL TIME ENROLLED IN COLLEGE.

Number of years completed	Freshman year grade point average							
	.00 to .49	.50 to .99	1.00 to 1.49	1.50 to 1.99	2.00 to 2.49	2.50 to 2.99	3.00 to 3.49	3.50 to 4.00	Total
Above 4 years		1	1-(1)	5-(5)	2-(2)	4-(4)	3-(3)		16-(15)
4 years			4-(1)	4	9-(6)	15-(14)	7-(7)	3-(3)	42-(31)
3 years but not 4 years		2	3	5	1				11
2 years but not 3 years		3	5	9	4	4	2	1	28
1 year but not 2 years	2	12	13	12	6	5	4	2	56
Less than 1 year	7	4	4	2	1	2			20
TOTAL	9	22	30-(2)	37-(5)	23-(8)	30-(18)	16-(10)	6-(3)	173-(46)

Figures in parentheses indicate number of students graduating.

From Table 11 it can be seen that only five out of 37 (13½ per cent) with grade point averages ranging from 1.50 to 1.99 in their freshman year succeeded in graduating and it took those five more than four years to earn

their degrees (Table 10). Only two students out of a total of 60 with freshman grade point averages of less than 1.49 succeeded in graduating. From this it may be assumed that a freshman grade point average of 2.00 represents the lower grade limit for any reasonable chance of graduating from the Forestry Division.

Table 11.--PERCENTAGE OF STUDENTS GRADUATING WHO MADE CERTAIN GRADE POINT AVERAGES IN THEIR FRESHMAN FORESTRY YEAR.

Grade point average	Number	Number graduating	Percentage
3.00 - higher	22	13	59
2.50 - 2.99	30	18	60
2.00 - 2.49	23	8	39
1.50 - 1.99	37	5	13.5
.00 - 1.49	61	2	3

It should be noted here that some changes in scholastic standards policies at Colorado Agricultural and Mechanical College have been made since 1935-36. The policy under operation at the present time (May, 1948) makes it mandatory to suspend from school all students who do not maintain a grade point average of 2.00 for any three consecutive quarters. Previously, students with an accumulative grade point average of less than 2.00 could remain in school longer.

Chapter V

DISCUSSION

The problem of making information on pre-forestry students available to advisers in order to provide more effective guidance for those students planning to major in forestry was resolved as follows:

1. Relationship between grades achieved during freshman year and graduation from the Forestry Division.

2. Relationship between test scores and grades achieved during freshman year.

3. Relationship between rank in high school graduating class and grades achieved during freshman year.

4. Factors or combinations of factors which appear to be most useful in forecasting scholastic performance.

5. Weights assigned to retained factors to secure best prediction of students' scholastic performance.

6. Means by which data may be used most effectively in counseling students who plan to seek entrance in the Forestry Division.

The reader will notice many references to Gould (20) and McClanahan (25) in this chapter. In 1944 Gould made a study of the general college population at Colorado Agricultural and Mechanical College (known at that time as Colorado State College of Agriculture and Mechanic Arts) to determine the relationship of test scores and high school rank to first semester grade point average. In 1947 McClanahan studied the relationship of test scores and high school rank to first-year grade point average for engineering students at Colorado Agricultural and Mechanical College. Therefore, it is important that comparisons between the general student population and academic division segments of the population be reviewed.

It will be noted that there is sufficient variance in the data presented in this study, as compared with the other two, to assume that need exists for studying performance of students enrolled in the other academic divisions at Colorado Agricultural and Mechanical College.

Freeman and Johnson (18), in 1942, substantiated this fact in a study at the University of Minnesota when they found it was necessary to develop separate predictive formulas for the divisions of agriculture, forestry, and home economics. Butsch (4), in 1939, in a study conducted at Marquette University, found the correlations for the colleges of business, engineering, journalism, and liberal arts ranged so greatly that he concluded, ". . . a parti-

cular section which furnishes the best single predictor for one college may be entirely negligible in its contribution for another." (4:420)

Relationship between freshman grades and graduation

A strong positive relationship was established between freshman grade point average and graduation for those freshman forestry students entering in September, 1935 and 1936. Only one student out of 14 with a freshman year grade point average of less than 2.00 succeeded in graduating.

A zero-order coefficient of correlation of .835 between first-year and four-year accumulative grade point averages was established for the 1935-36 sample. This tends to show that scholastic performance in the freshman year will be representative of the student's scholastic performance for his entire time in college.

The ratio of graduating students to "drop-outs" became increasingly higher as the freshman year grade point average increased. The term "drop-out" is used rather than "failure" because many factors other than scholastic inaptitude cause students to withdraw from college. Financial problems may have accounted for many of the drop-outs in the 1935-36 sample for it must be remembered that these students were in college in the days of the depression of the 1930s. Despite the many factors

which cause "drop-outs," 52 per cent of those students in the sample with an accumulative average of 2.00 or better succeeded in graduating. This compares quite favorably with the 56 per cent of engineering students graduating who had accumulative averages in their freshman year of 2.00 or better, as reported by McClanahan (25).

On the basis of the evidence, a grade point average of 2.00 may be interpreted as the critical grade point for the freshman forestry year below which students have very little chance (one in 14) of graduating from the Forestry Division.

Test scores and grades achieved in freshman year

The English test gave the highest correlation, $r = .637$, for any single variable and freshman grade point average. Gould (20) found that the A.C.E., with an r of .63 was the best single predictor for the general college population. McClanahan (25) found the best single predictor for freshman engineers to be the Chemistry test with an r of .652.

McClanahan (25) reported an r of .583 between the English test and grades, while Gould (20) found an r of .558 between the English test and first semester general college grades. The r of .637 on the English test for freshman forestry students was higher than the two above with all three correlations being made on Colorado

Agricultural and Mechanical College students. Apparently the English test measures more efficiently certain qualities that predict success in forestry. It would be of interest to know if similar results could be obtained by studying subsequent groups. In this connection it should be pointed out that the group studied by Gould (20) in 1944 was a war-time group with the freshman class comprised largely of women students and those men exempt from active military service and thus might be questioned as being a representative group.

The coefficient of correlation between the A.C.E. and freshman grade point average was $r = .618$ which was second in predictive efficiency of the tests studied. McClanahan reported an r of .648 for the A.C.E., while Gould (20) found $r = .63$ for the same test. This represented close agreement for the three groups studied. Wagner (38), in 1934, compiled a summary of prediction studies and reported that correlations between the A.C.E. and college grades ranged from .17 to .81.

Since the publication of Gould's study in 1944, the Office of Student Affairs at Colorado Agricultural and Mechanical College has assumed that the A.C.E. was the most efficient of the tests in the basic test battery in predicting success for the general college population. There is a need to check again predictive efficiency of the various tests in terms of predicting performance for the general college students.

The Reading test, with an r of .547 with first-year grade point average, was third in efficiency among the four tests as a predictor of first-year grades. This was somewhat higher than the r of .495 reported by McClanahan (25) for association with success in engineering.

The Chemistry test was found to be the least efficient (r = .496) of any of the variables studied as a single predictor of freshman year grade point average for freshman forestry students. This finding was diametrically opposed to that of McClanahan (25) who reported that the Chemistry test was the best single predictor of freshman year grade point average for engineering students. The Chemistry test is primarily a measure of aptitude in the physical sciences, and it has been demonstrated that it will be more efficient in predicting successful performance in engineering since the engineering curriculum is heavily weighted with courses in the physical sciences.

Although the Chemistry test, as a single test, was the least efficient of any of the tests in predicting grades of pre-forestry students, it will be pointed out that the test is one of the most valuable in the basic battery since it produces a marked increase in predictive efficiency when used in combination with other variables.

High school rank
and grades achieved
in freshman year

High school rank, with an r of .521, was next to the lowest of the variables studied in terms of efficiency in predicting freshman year grade point average. This is in direct contrast with some of the findings of other investigators. Emme (15) in 1942 reported that rank in high school graduating class seemed to be the best single criterion for predicting success in college as compared with seven other criteria studied. Strang (36), Requa (28), Thurber (37), and others found a strong relationship between rank in high school graduating class and academic success in college.

There is some chance that a higher correlation between high school rank and freshman year grade point average in the 1946 sample might have been obtained had there been a greater number of cases with high school rank available. Out of the 94 cases in the 1946 sample, there were only 48 who had notations in their records indicating where they stood scholastically in their high school graduating classes. With an "n" of only 48 there might be some question as to the reliability of the correlation, and particularly so when the high school rank percentage for many cases was established by taking the mid-point of the high school quartile ranking. However, this appeared to be the only feasible way to convert quartile ranking to percentage rank.

It should be pointed out, however, that the highest multiple coefficient of correlation for any three variables with grade point average was obtained for a combination which included high school rank as one of the variables.

Intercorrelations between variables

Intercorrelations between variables used in this study indicated that the A.C.E., English, and Reading tests tended to measure common factors. The intercorrelations between the three tests were as follows:

A.C.E. and English. . . . . r = .701

A.C.E. and Reading. . . . . r = .717

English and Reading . . . . r = .701

The correlations between the Chemistry and the other three tests show that the Chemistry test measures different factors. The intercorrelations were as follows:

Chemistry and A.C.E.. . . . r = .220

Chemistry and English . . . r = .270

Chemistry and Reading . . . r = .147

McClanahan (25) in his study of freshman engineering students found a much wider range of intercorrelations between Chemistry and the other tests, the range being from .157 to .543.

The intercorrelations between each of the four tests and high school rank ranged from .355 with the Reading test to .458 with the A.C.E.

Combinations of variables and grade point average

The combination of the A.C.E. and Chemistry tests and high school rank with freshman year grade point average produced the highest multiple correlation coefficient of any of the combinations studied, the R being .762. The combination of the A.C.E., English, and Chemistry tests was only slightly lower, the correlation being .756. Combinations of three variables with grade point average gave multiple correlations ranging from R = .683 to R = .762.

A review of Table 9 reveals that when the Chemistry test was dropped from the combination of variables there was a significant drop in the multiple correlation.

The multiple correlation coefficient of .721 between the English and Chemistry tests and grade point average was the highest multiple R obtained for any combination of two variables with grade point average. The others ranged from R = .619 to R = .720. Again, removing the Chemistry test from the combination resulted in a significant drop in the multiple R.

Durflinger (12), in 1943, in his summary of studies involving multiple correlations stated that median multiple correlations ranged from R = .600 to R = .700. The median multiple correlations found in this study appear to compare favorably with others reported in the literature.

Wagner (38) summarized a number of prediction studies and reported that multiple coefficients of correlation of .80 are rarely exceeded regardless of the variables used.

McClanahan (25) reported a multiple coefficient of correlation of .848 between a combination of five variables and grade point average in engineering which is one of the highest multiple correlations reported in the literature for prediction studies.

Weights assigned to retained factors

The combination of the English and Chemistry tests appeared to be the most feasible combination for predicting freshman year grade point average. This combination produced an R of .721 as compared with an R of .762 for the most efficient combination of three variables and grade point average. The slight increase in prediction efficiency gained by adding one more variable would not justify the added labor and time involved. This is in accordance with the findings of Williamson and Bordin (39) who reported that for practical purposes combinations of two variables will give multiple correlations only slightly less valid than combinations containing added variables.

Some readers may wonder why the combination of the A.C.E. and Chemistry tests with grade point average (R = .720) was not selected as the most desirable combination of two variables, since the A.C.E. is widely known as

a test measuring general mental ability. The A.C.E. test is subject to change more often than the English test and there is no way of ascertaining that new forms of the test will produce identical measures with the previous forms. The 1947 form of the A.C.E. test is being purchased by the Office of Student Affairs, Colorado Agricultural and Mechanical College, for use with the freshman class of 1948 and there was no assurance that the new form of the test would produce the same measurements as the one (1943 edition) used in this study.

Using the English and Chemistry test scores, a regression equation was developed to predict the freshman year grade point average, W. This equation is

$$W = .009_{x2} + .008_{x3} + .584,$$

with the English raw score representing x2 and the Chemistry raw score, x3.

The coefficient of forecasting efficiency for the R of .721 reported for the combination of English and Chemistry with grade point average was computed to be E = .307. This means that predictions based on this combination of variables are 30.7 per cent better than predictions based on chance.

The standard error of estimate of .47 means that 68 cases out of 100 should achieve a grade point average within a range of .47 grade point average above or below the predicted grade point average.

Predicted grade point averages for the 49 cases in the 1945 sample were obtained by use of the regression equation. The zero-order coefficient of correlation between predicted grades and achieved grades for the sample was $\underline{R}$ = .461. Thirty-two per cent of the students achieved grade point averages that were significantly below those predicted by use of the regression equation. Eight per cent of the students achieved grades significantly higher than those predicted by the regression equation.

The scatter diagram of frequency distributions of predicted grade point averages plotted with achieved grade point averages revealed that the regression equation was unusually effective in singling out those students who should be identified as early as possible for counseling purposes. The regression equation applied to the 1945 sample resulted in predicting that seven students would achieve freshman year grade point averages of less than 1.75. All seven students did achieve below 1.75 average for their freshman year. This was 100 per cent predictive efficiency for this segment of the sample population.

The correlation of .461 between predicted and achieved grades might appear to be somewhat lower than normally would be expected. It should be noted that 16 of the 49 cases achieved grades that were significantly below those predicted. Problems of adjustment and motivation contributed to the performance of these 16 cases. There is

no means of measuring motivation of "drive" to succeed and neither is there any method of forecasting the type and extent of adjustment problems with which the student may be confronted. It should be remembered that the 1945 sample was comprised largely of World War II veterans who were the first to be separated from the service because of length of service or who were discharged early because of service-incurred disabilities. There is some reason to assume that these men may have faced greater adjustment problems than those enrolling since the fall of 1945. This would tend to reduce the correlation between achieved and predicted grades.

Effective use of data in counseling

Under present policies of operation at Colorado Agricultural and Mechanical College, freshman students apply for entrance to the Forestry Division during the spring quarter of their freshman year. This means that they have approximately six months' time in which to discuss with their faculty advisers or staff members in the Office of Student Affairs the possibilities of entering forestry training.

Faculty advisers are often undecided as to whether they should encourage students to apply for admission to the Forestry Division. This is particularly true during the first quarter of the school year before

the student has established a college achievement record which can be used as a basis for objective judgment. By use of the Chemistry and English test scores and the regression equation the adviser may determine the probability of the student's achieving a freshman year grade point average which will place him among those eligible to be considered for admission to the Forestry Division.

The computation involved in ascertaining the most probable grade point average from a regression equation would tend to discourage many advisers from using these devices in estimating the chances a student has of obtaining a certain grade point average.

The regression equation developed in this study is based on raw scores. However, only percentile scores are made available to faculty advisers, since heretofore advisers have had no means of using raw scores. To obtain raw scores for any student, it is only necessary for the adviser to call the Office of Student Affairs.

In order to encourage the use by advisers of raw data on the Chemistry and English tests, a nomographic predictive charge, Figure 1, was developed by the method described by Lipka 1/. This chart is designed to aid in counseling freshman students who wish to enter the Forestry Division. By use of this chart, it is possible to read the predicted grade point average when raw scores on the

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1/ Joseph Lipka, Graphical and Mechanical Computation. New York. John Wiley and Sons, Inc., 1918, pp. 45-46.

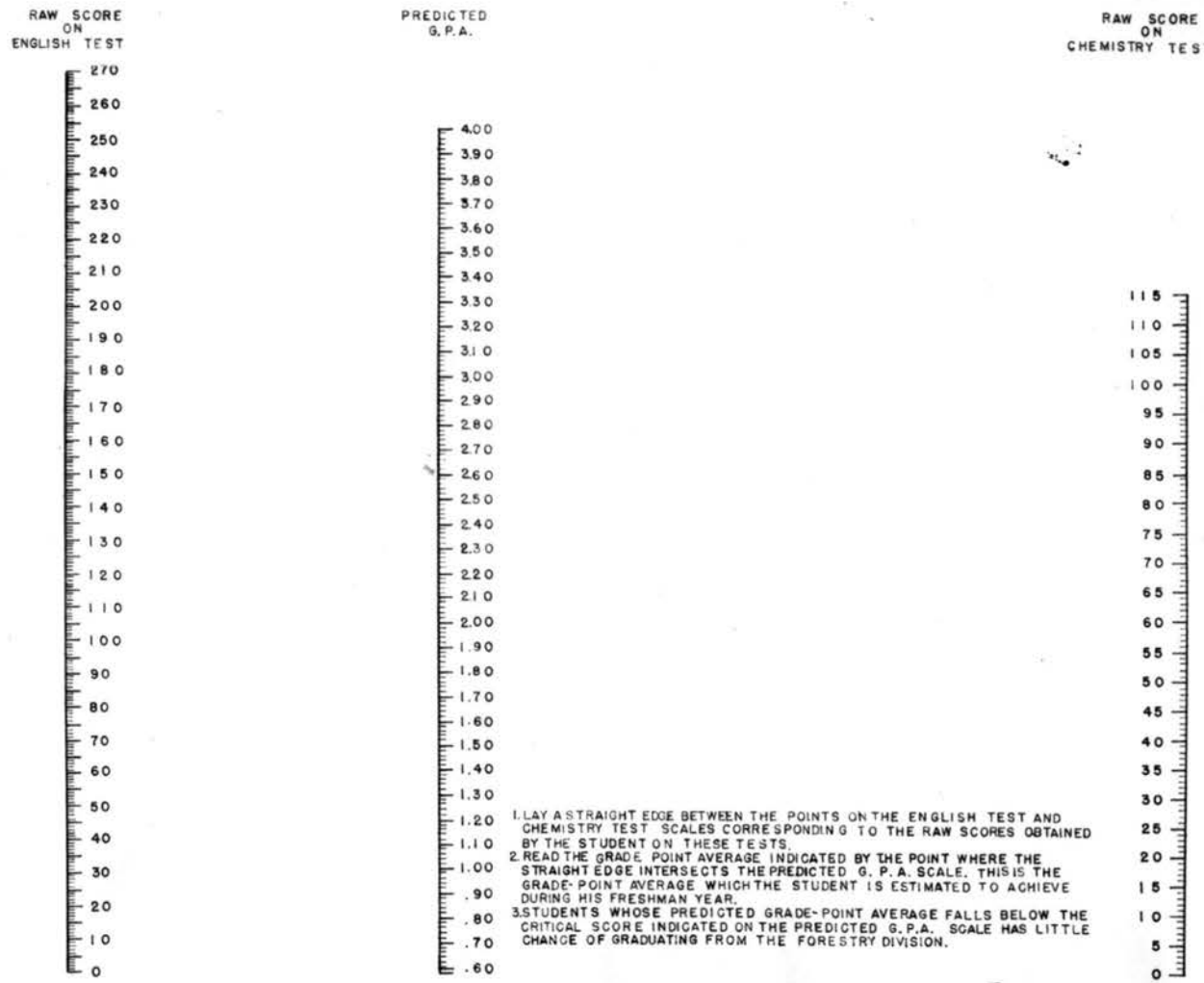

FIGURE 1 - NOMOGRAPHIC CHART FOR PREDICTING FIRST YEAR GRADE POINT AVERAGE FOR PRE-FORESTRY STUDENTS FROM RAW SCORES ON THE ENGLISH AND CHEMISTRY TESTS.

English and Chemistry tests are known.

Advisers should find the nomographic chart a practical device for determining at a glance the predicted grade point average. Interpretation of the predicted grade point average demands a certain amount of skill and knowledge in counseling techniques on the part of the adviser. In using the chart, advisers must recognize that they are applying to a single student the results of a study conducted on a group that is quite heterogeneous in terms of degree of motivation, educational background, age, maturity, marital status, and other related factors.

Advisers must realize that test scores represent a broad band or "range" of performance rather than precise measurement. They must also realize that actual performance may vary widely from predicted performance since many of the factors which affect performance are not measured. Williamson and Bordin (39) stated that "At the present time such factors can be identified, if at all, only by clinical diagnosis and can be given weighing only by crude judgements." (39:4)

Faculty advisers should find information presented in this study helpful in the following respects in counseling students wishing to major in forestry:

1. When the adviser discovers a wide discrepancy between achievement and indicated ability, he should refer the student to the Office of Student Affairs for clinical counseling.

2. The adviser may wish to refer the student to the Office of Student Affairs for counseling early in the freshman year when he sees that indicated abilities give the student very little chance of performing at a level acceptable for admission to the Forestry Division.

3. The adviser may recommend the student take a limited number of hours in view of low indicated performance.

Recommendations for further study

This is the second study to be completed at Colorado Agricultural and Mechanical College dealing with the problem of predicting success for students in specific academic divisions. The first study by McClanahan (25) dealt with predicting success for students in the Engineering Division. His study of engineering students varied in enough respects with this study of forestry students to demonstrate that separate studies in predicting success should be conducted for each academic division of the college. Prediction studies for the Divisions of Agriculture, Home Economics, Science and Arts, and Veterinary Medicine should be made as soon as possible to facilitate the student counseling program.

Further studies of prospective forestry students should be conducted to determine the effect of personality

and interest on performance. In the school year, 1947-48, a vocational interest test was administered to all forestry freshmen. These data are available and a study of the data should produce valuable information for predicting performance. Some standard personality test, such as the Bernreuter, might be administered to one class to determine if personality factors can be measured which will assist in predicting success in forestry.

Studies of subsequent freshman forestry classes, using criteria developed in this study, should be conducted to determine if the 1946 sample on which this study is based is truly representative of the classes to follow.

Upon graduation a high percentage of the forestry graduates take federal civil service examinations for positions in the Forest Service, Grazing Service, Soil Conservation Service, and Fish and Wildlife Service. A study should be made to determine the relationship of scholastic performance to performance on the civil service examinations. Results of such a study would be most useful to counselors in the Forestry Division.

There is also a need for studying the relationship of high school rank to scholastic performance. Neither this study nor that of McClanahan (25) produced conclusive results on predictive efficiency of high school rank because it was felt that there were not enough cases with high school rank recorded to represent effective sampling.

This study should be made for the general population as well as for the separate academic divisions.

Chapter VI

SUMMARY

This study was undertaken for the purpose of determining whether additional information could be made available to advisers of pre-forestry students in order to provide better guidance for those students planning to major in forestry. Advisers of pre-forestry students are routinely provided with information on each student on the measures listed below.

Raw data were gathered on 94 students enrolling in September, 1946, who indicated a preference for forestry training. The data consisted of scores on six variables as follows:

1. Freshman year grade point average . . variable 1
2. American Council on Education Psychological Examination . . . . . variable 2
3. Cooperative English test, Form P.M. . variable 3
4. Iowa Placement test, Chemistry Aptitude . . . . . variable 4
5. Nelson-Denny Reading test . . . . . variable 5
6. High school rank. . . . . variable 6

Zero-order coefficients of correlation between each variable and first-year grade point average were as follows:

1. r12 = .618
2. r13 = .637
3. r14 = .496
4. r15 = .547
5. r16 = .521

The best single predictor of freshman grade point average for pre-forestry students was the English test, followed by the A.C.E., the Reading test, high school rank, and the Chemistry test. Intercorrelations showed that the A.C.E., English and Reading tests tend to measure common factors.

Multiple coefficients of correlation were computed between combinations of variables in order to determine a combination that would give the most efficient prediction of success in forestry. The combinations producing the highest multiple correlations were as follows:

1. r1.246 = .762
2. r1.234 = .756
3. r1.34 = .721
4. r1.24 = .720

When the Chemistry test was removed from the combination of variables there was a significant drop in the multiple coefficient of correlation.

The combination of the English and Chemistry tests and grade point average was the most practical combination to use in counseling. Addition of other variables

did not increase the multiple correlation sufficiently to justify the additional time and effort involved.

Using the English raw score as x2 and the Chemistry raw score as x3 the following regression equation was computed:

$$W = .009_{x2} + .008_{x3} + .584.$$

The regression equation applied to the 1945 sample resulted in predicting that seven students would achieve freshman year grade point averages of less than 1.75. All seven students achieved less than a 1.75 average for their freshman year. This was 100 per cent predictive efficiency for this segment of the sample population.

A study of 173 freshman students entering the Forestry Division in September, 1935 and 1936, was made in order to develop a critical freshman grade point average. It was found that students achieving below a freshman year grade point average of 2.00 had only one chance in 14 of graduating. Therefore, the critical grade point average of 2.00 was selected.

The regression equation and the standard error of estimate were used to develop a nomographic predictive chart. This chart predicts the most probable grade point average from raw scores on the English and Chemistry tests. By using this chart, advisers should be able to estimate the chances of the student's succeeding scholastically and the advisers should also be able to identify and refer

for clinical counseling students who appear to have little chance of succeeding in forestry.

A P P E N D I X

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Appendix A.--VARIATES USED IN THE STUDY OF THE 1935 AND 1936 SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Appendix A.--VARIATES USED IN THE STUDY OF THE 1935 AND 1936 SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
1	1.59	1.60	2½
2	2.03	1.44	2
3	.81		½
4	2.09	1.80	3
5	2.57	2.33	4
6	2.01		1
7	3.91		1
8	1.81	1.81	2
9	1.31		½
10	1.06		1
11	3.15		1
12	.89		½
13	.03		½
14			
15	2.78	2.70	4
16	.41	.91	1½
17	1.91		1
18	.98		1
19	2.62		½
20	1.97		½
21	1.08		1
22	2.97	2.82	4

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
23	1.91	1.59	3
24	1.65	1.86	3½
25	1.65	1.53	4
26	1.33	1.56	2
27	1.60	1.72	4
28	1.59		½
29	1.01	.91	1½
30	1.75	1.52	2½
31	.62		½
32	2.56		1
33	.55	.74	1
34	.07		½
35	1.33	1.32	2
36	3.50	3.29	4
37	1.91		1½
38	3.31	3.50	5
39	1.84	2.68	5½
40	2.13		1
41	.85	.81	1½
42	1.28	1.57	4
43	3.83	3.72	4
44	.83	.73	1½

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
45	1.25		1
46	1.15	1.08	1½
47	2.87	2.92	4
48	2.14	2.02	4
49	2.51		1
50	2.07	1.75	6
51	1.21	1.63	1½
52	2.24	2.34	6
53	2.17	2.76	4
54	1.06	1.45	4
55	3.20		1
56	.81	.80	3
57	1.34	2.52	4
58	1.93	2.20	4
59	3.89		1
60	1.88		1
61	2.84	3.33	4
62	.24		½
63	2.66		½
64	3.47	2.89	5
65	2.75	2.72	5
66	2.28	2.25	4

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
67	.57	1.09	2½
68	2.59		1
69	1.62		1
70	2.12	2.02	4
71	1.77	1.76	2
72	1.56	1.88	2
73	2.24	2.23	4
74	1.69	1.79	1½
75	.64		1
76	1.25	1.22	3
77	2.62		1
78	.14		½
79	1.85	1.79	2
80	1.47	1.50	1½
81	2.44	2.55	2
82	.59		½
83	2.13	2.42	4
84	1.18		1
85	2.53	2.83	4
86	2.16	1.72	2
87	3.27	3.06	4½
88	1.53	1.44	3

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
89	.95	1.19	1½
90	2.37	2.50	2
91	.75	.82	2
92	2.80	2.39	4
93	1.61	1.52	2
94	.91	1.78	5
95	1.81		1
96	3.44	2.72	4
97	.53		1
98	.89		1
99	2.17	1.75	1½
100	2.66	2.36	4
101	1.34		½
102	.95		1
103	1.38		1
104	3.08	3.00	4
105	1.50	1.57	4
106	1.56	2.26	4½
107	1.82		1
108	.72		1
109	1.56	1.64	2
110	3.53	3.49	2

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
111	2.84	2.07	4
112	.89	1.01	1½
113	1.12	1.04	2
114	.34		½
115	2.12	2.44	4
116	2.70	2.44	4
117	1.17		½
118	3.06	3.10	2
119	.07		½
120	1.36		1
121	1.54		1
122	.28		½
123	3.38	2.85	4
124	2.14	1.94	4½
125	2.65	2.70	4
126	2.91	2.90	2
127	1.94	2.22	2
128	1.38		1
129	3.11	3.36	4
130	2.91	2.90	4
131	2.75	2.81	2
132	2.56	2.54	4

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
133	2.63	2.69	4
134	3.15	3.02	4
135	1.33	1.29	2
136	1.69	1.84	5
137	2.72	1.91	1½
138	1.51	1.41	3
139	1.48		1
140	2.56	2.22	4
141	1.75	2.17	5½
142	2.38	1.91	1½
143	2.06		½
144	1.23	1.27	3
145	3.26	3.40	4
146	.84	1.49	2½
147	2.13		1
148	3.00		½
149	1.15		1
150	3.21	2.90	4
151	2.19		1
152	1.75		1
153	2.16	1.93	4
154	2.72	2.55	4

Appendix A.--Continued

Case Number	First-year grade-point average	Accumulative grade-point average	Time in college (years)
155	.72	.87	3½
156	1.43	1.44	3
157	2.78	3.11	2
158	1.37	.95	1½
159	1.65	2.43	4½
160	1.22	1.41	4
161	1.69	1.62	3
162	.45		1
163	1.82		1
164	.60		1
165	3.53	2.84	4
166	2.61		1
167	3.21	2.97	2
168	3.17	2.92	1½
169	1.56		½
170	2.83	2.97	4
171	2.95	2.69	4
172	1.11		1
173	1.69	2.80	3½

Appendix B.--VARIATES USED IN THE STUDY OF THE SEPTEMBER, 1946, SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Appendix B.--VARIATES USED IN THE STUDY OF THE SEPTEMBER, 1946, SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
1	.13	106	136	15	74	.95
2	.39	130	205	47	99	3.07
3		92	121	32	59	1.79
4		129	180	14	111	1.50
5		109	96	59	72	2.21
6	.70	119	127	52	83	2.19
7	.87	126	218	87	109	2.95
8	.23	79	96	14	65	1.89
9	.62	127	101	46	74	2.16
10	.87	119	183	105	82	2.43
11		121	205	28	91	2.32
12	.31	107	129	36	69	1.18
13	.42	111	200	15	103	2.25
14		106	127	22	80	1.81
15	.13	87	132	16	57	1.65
16		121	141	97	78	2.52
17		89	109	14	67	1.26
18	.62	77	107	6	45	.88
19	.38	74	104	6	38	.57
20		99	110	71	59	2.50
21	.13	42	93	6	52	.91
22	.13	89	125	14	69	1.74

Appendix B.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
23	.59	96	141	35	63	2.50
24		70	127	14	86	1.78
25		123	162	22	87	2.04
26	.83	165	200	61	128	3.61
27	.58	107	112	114	77	1.72
28	.41	100	154	42	70	2.06
29		138	200	64	100	2.45
30		77	120	61	54	1.98
31		99	123	20	77	2.91
32		81	84	6	60	1.99
33	.38	134	172	14	83	2.07
34	.99	144	220	56	109	3.33
35	.13	106	121	12	80	1.32
36	.87	115	127	50	88	2.12
37		135	218	105	109	3.76
38		95	159	50	80	2.22
39	.69	82	134	6	58	1.86
40	.47	115	136	55	76	1.93
41		97	125	22	73	1.92
42		100	113	32	68	.65
43	.87	142	209	73	128	3.50
44		90	119	14	68	2.04

Appendix B.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
45		94	121	14	72	1.70
46		123	120	16	63	2.39
47	.54	119	190	31	94	2.33
48		130	175	64	88	2.35
49	.06	151	187	35	94	1.62
50		126	96	47	72	1.77
51		113	147	14	77	1.13
52	.81	108	160	29	72	2.63
53		115	218	82	85	2.22
54	.87	127	190	36	92	2.02
55	.13	97	190	15	94	1.72
56	.62	109	194	61	78	3.17
57	.87	123	84	14	74	1.97
58	.13	114	110	69	92	1.45
59	.13	107	155	66	60	2.68
60		104	93	6	57	1.07
61		111	159	41	89	2.52
62		123	192	41	86	2.64
63	.62	101	209	71	80	2.26
64	.93	92	170	12	78	2.66
65	.26	87	104	22	58	1.43
66	.87	152	246	67	82	3.11

Appendix B.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
67		102	109	50	63	2.08
68		154	202	14	128	2.42
69		96	157	28	54	2.64
70	.32	107	123	41	84	2.41
71		124	155	41	69	2.79
72		151	231	102	109	3.00
73	.62	97	139	27	77	2.15
74		114	179	76	56	2.39
75		118	145	14	59	2.04
76		108	96	90	56	2.15
77		117	157	9	88	1.87
78	.62	91	109	6	74	2.05
79	.34	119	157	85	88	2.15
80		123	172	66	103	2.29
81		104	104	17	68	2.00
83	.86	148	227	41	95	3.06
84	.87	129	213	50	117	3.30
85		119	159	78	90	3.51
86		117	124	76	64	2.34
87	.52	165	223	88	88	3.11
88		76	75	6	49	1.91
89		97	125	71	56	2.23

Appendix B.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
90	.13	106	130	22	87	2.17
91		90	139	22	68	1.24
92		104	136	20	59	1.88
93	.87	144	203	107	106	3.06
94	.62	61	60	6	41	.77

Appendix C.--VARIATES USED IN THE STUDY OF THE SEPTEMBER, 1945, SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Appendix C.--VARIATES USED IN THE STUDY OF THE SEPTEMBER, 1945, SAMPLE OF FRESHMAN FORESTRY STUDENTS.

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
1		129	175	85	109	1.80
2		100	153	32	84	2.88
3		119	205	83	104	2.64
4	.80	119	123	79	68	2.62
5		127	187	75	78	1.63
6	.26	87	93	16	41	1.74
7		111	170	22	82	2.04
8	.81	117	166	107	74	1.44
9	.81	106	157	67	64	1.58
10		125	223	32	132	2.55
11		104	133	15	83	2.31
12	.32	99	109	30	70	1.51
13		138	205	44	83	1.81
14		102	192	36	100	.96
15	.56	95	106	15	62	.56
16		86	134	16	92	2.02
17		76	133	6	60	2.57
18		129	153	42	84	1.91
19		123	133	40	74	2.00
20	.85	115	179	87	70	1.83
21	.75	102	144	6	88	2.31
22	.49	104	145	15	92	2.62

Appendix C.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
23	.91	127	157	107	113	2.54
24		77	154	11	77	2.78
25	.35	106	200	23	89	2.14
26		111	155	6	97	1.83
27	.87	135	209	43	128	1.81
28		85	93	11	40	.71
29	.18	85	84	6	58	.00
30	.70	115	200	75	104	2.58
31	.13	140	167	54	90	1.86
32	.99	76	139	14	40	1.88
33	.71	130	158	85	90	.94
34	.41	91	160	25	77	2.05
35	.13	129	148	51	106	1.90
36	.02	42	62	9	35	1.22
37		129	209	107	120	2.77
38	.92	120	145	63	56	2.33
39		107	177	16	77	1.76
40	.69	100	127	20	73	2.44
41	.77	102	115	28	65	.51
42		144	266	78	106	3.33
43	.95	148	227	107	107	3.17
44		102	143	28	72	1.04

Appendix C.--Continued

Case Number	H.S.R.	A.C.E.	English	Chemistry	Reading	First-year grade-point average
45	.90	144	242	78	98	2.32
46	.12	106	124	15	78	1.46
47	.40	165	246	90	138	1.22
48		100	192	15	109	1.55
49		117	157	50	84	1.36

Appendix D.--SCATTER DIAGRAM OF RELATIONSHIP OF PREDICTED GRADE-POINT AVERAGES TO ACHIEVED GRADE-POINT AVERAGES FOR 1935-36 SAMPLE.

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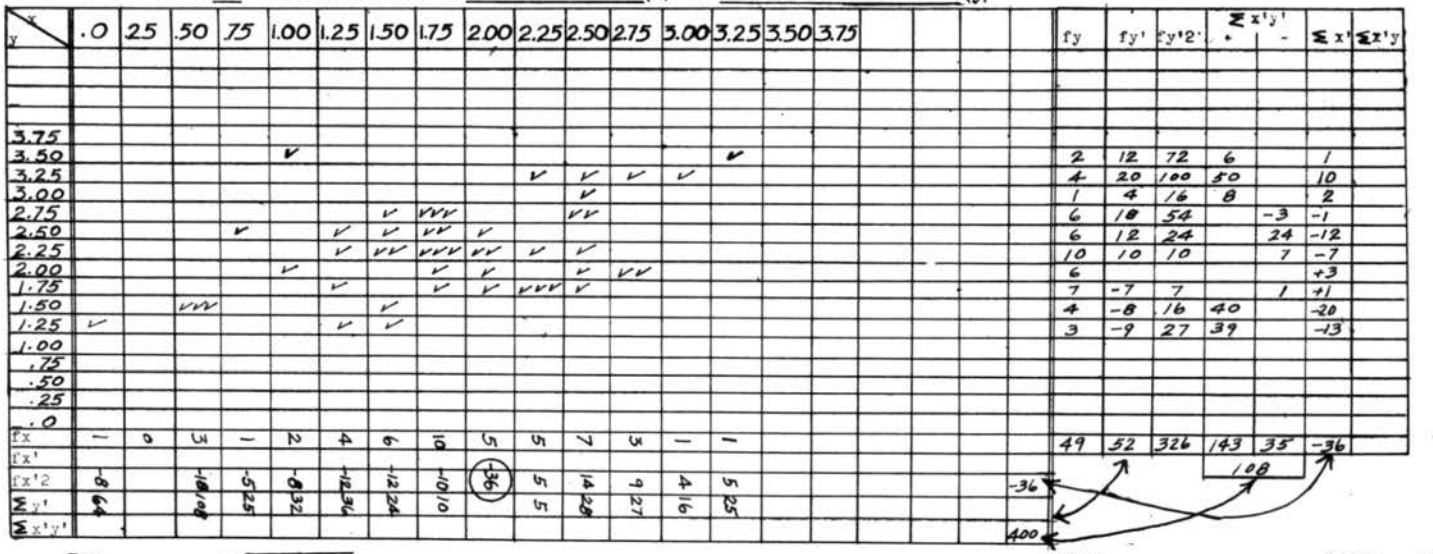
Appendix D.-- Scatter diagram of relationship of predicted grade point averages to achieved grade point averages for 1945 sample.

Table ___. Correlation between Achieved G.P.A. (x) and Predicted G.P.A. (y)



y \ x	.0	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	fy	fy'	fy'2'	Σx'y' +	Σx'y' −	Σ x'	Σx'y
3.75																							
3.50					V									V			2	12	72	6		1	
3.25										V	V	V	V				4	20	100	50		10	
3.00											V						1	4	16	8		2	
2.75							V	VVV			VV						6	18	54		-3	-1	
2.50				V		V	V	VV	V								6	12	24		24	-12	
2.25						V	VV	VVV	VV	V	V						10	10	10		7	-7	
2.00					V			V	V		V	VV					6					+3	
1.75						V		V	V	VVV	V						7	-7	7		1	+1	
1.50			VVV				V										4	-8	16	40		-20	
1.25	V					V	V										3	-9	27	39		-13	
1.00																							
.75																							
.50																							
.25																							
.0																							
fx	1	0	3	1	2	4	6	10	5	5	7	3	1	1			49	52	326	143	35	-36	
fx'									(-36)											108			
fx'2	-864		-1008	-525	-832	-1224	-1224	-1010		55	1428	927	416	525			-36						
Σx'y'																	400						

$C_{x'} = \frac{\Sigma fx'}{N}$ $\quad \sigma x = \sqrt{\Sigma fx^2 - c^2x}$ $\quad$ S.D.x $= \sigma x_1$ $\quad M_x = GM_x + cx_1$

$C_{x'} = .734$ $\quad \sigma x = 2.76$ $\quad$ S.D.x = $\quad M_x =$

$C^2x = .535$

$C_{y'} = \frac{\Sigma fy'}{N}$ $\quad \sigma y = \sqrt{\Sigma fy^2 - c^2y}$ $\quad$ S.D.y $= \sigma y_1$ $\quad M_y = GM_y + cy_1$

$C_{y'} = 1.061$ $\quad \sigma y = 2.35$ $\quad$ S.D.y = $\quad M_y =$

$C^2y = 1.123$

$r_{xy} = \frac{\frac{\Sigma x'y'}{N} - C_yC_x}{\sigma x \, \sigma y}$ $\quad PE_r = \frac{.6745(1 - r^2)}{\sqrt{N}}$

$r_{xy} = 2.204$ $\quad PE_r =$

$+ .778$

$\frac{2.982}{6.486} = r = .461$ (3026-47)

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