

ABSTRACT OF THESIS

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PREDICTION OF SUCCESS  
IN  
PRE-VETERINARY MEDICINE

Submitted by  
Lon Stephens

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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PREDICTION OF SUCCESS  
IN PRE-VETERINARY MEDICINE

Introduction

The great increase in the enrollment of colleges since the end of World War II has created many problems for the educational institutions of the United States. The Colorado Agricultural and Mechanical College has had such an increase in enrollment that some divisions of the college have found it necessary to limit drastically the number of students admitted.

The Division of Veterinary Medicine has increased the number of admissions made into that division to the full capacity of all available facilities. Sixty students are now admitted each year into that division, but this number is only a small percentage of those seeking admittance. Competition for entrance into this department of the college is naturally keen because of the limited number of students accepted.

A student must spend three full quarters in pre-veterinary medicine before he becomes a candidate for admission into the school of veterinary medicine. Beginning with the school year of 1948-49, an additional year of pre-veterinary medicine will be required before the student

becomes a candidate for admission into the school of veterinary medicine.

A counseling problem exists in giving proper guidance to students that plan to enter the course in pre-veterinary medicine at Colorado Agricultural and Mechanical College because the number of students registering for pre-veterinary medicine is so large. The student and the college would benefit, if, through the guidance program at the time of entrance, those that will fail to do the caliber of college work required for entrance into the veterinary school could be directed into other departments of the college that do not require such a high scholastic achievement.

It has been the practice at Colorado Agricultural and Mechanical College to furnish counselors with data which may assist them in determining the potentialities of entering freshmen. These data consist of the scores of the student on psychological tests, which are administered to all entering freshmen, and his relative rank with other students in his high-school graduating class. The value of these data available to counselors depends largely upon the prognostic value for a particular college division. Since grades are largely the basis for selection of students into the school of veterinary medicine, counselors need to know the relationships that exist between these data and grades achieved during pre-veterinary medicine.

### The problem

The problem of this study is: How can the data available to advisors be used most effectively in the counseling program of Colorado Agricultural and Mechanical College for the guidance of freshmen students planning to enter pre-veterinary medicine?

Analysis of the problem.--1. What relationship is there between scores achieved by freshmen students on the entrance examinations and grades achieved in pre-veterinary medicine?

2. What relationship is there between grades achieved during pre-veterinary medicine and high-school achievement, expressed in terms of rank in the high-school graduating class?

3. What factors or combination of factors considered are of optimum value in predicting grade-point average for students of pre-veterinary medicine?

4. Of the criteria retained, what weights should be assigned to secure optimum prediction of a grade-point average for students of pre-veterinary medicine?

5. How may the data be used by counselors in the guidance of freshmen students planning to enter pre-veterinary medicine at Colorado Agricultural and Mechanical College?

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

1. Students admitted as freshmen during the Fall quarter of 1945 and the Fall quarter of 1946.

2. The examinations administered to entering students: 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 obtainable from the records of students on file in the Office of the Registrar and the Office of Student Affairs, Colorado Agricultural and Mechanical College.

The study has been limited to the above for the following reasons:

1. Only those students entering the course in pre-veterinary medicine as freshmen were selected because students transferring from other divisions of Colorado Agricultural and Mechanical College, and from other colleges, cannot be compared with entering freshmen.

2. The standardized tests are administered to all entering students and the data made available to counselors at Colorado Agricultural and Mechanical College.

#### Methods and materials

Those freshmen students that entered Colorado Agricultural and Mechanical College for the Fall quarter of

1946-47 in pre-veterinary medicine were selected as the population for this study, since this was the first large group that produced the problem of giving proper guidance to students planning to enter this course.

Data for this study were collected from the files of the office of student affairs and the office of the college registrar. The office of the registrar provided the scholastic record of each freshman student that entered pre-veterinary medicine the Fall quarter of 1946-47. The office of student affairs was the source of the following data that were furnished to counselors:

1. Raw scores made by the students on the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude Test.

2. Raw scores made by the students on the Cooperative English Test, Form PM.

3. Raw scores made by the students on the American Council on Education Psychological Examination for High School Seniors and College Freshmen, 1943 Edition.

4. Raw scores made by the students on the Nelson-Denny Reading Test for Colleges and Senior High Schools.

5. The position of the student in his high-school graduating class.

Hereafter the above will be referred to as:

1. the Chemistry test, 2. the English test, 3. the A.C.E. test, 4. the Reading test, and 5. high-school rank.

The data listed above were collected for freshmen pre-veterinary students of 1945 for the purpose of checking the results of the study.

#### Groups studied

A list of all students registered in pre-veterinary medicine during the school year 1946-47 was made up from the student body lists for each quarter. To determine those that had no previous college training it was necessary to check the application for admission to Colorado Agricultural and Mechanical College and the registration blank for the first quarter for each student listed in pre-veterinary medicine. The same procedure was followed to obtain the list of all pre-veterinary medicine students for 1945-46.

Data for the freshmen entering the course in pre-veterinary medicine were studied to determine the relationships between these data and the criterion of success in pre-veterinary medicine.

The only criterion of success in pre-veterinary medicine that was measurable was grade-point average for the three quarters of 1946-47. A grade-point average of 3.0 was the lower limit of those considered for possible entrance into the school of veterinary medicine.

Of the 199 freshmen that entered in pre-veterinary medicine the Fall quarter of 1946-47, 13 withdrew from college before the quarter ended. Eight registered in

another department of the college at the beginning of the Winter quarter and 13 withdrew from college that quarter. The Spring quarter, 16 registered in a different course and 21 withdrew from college. Of the 199 freshmen that entered the course in the Fall quarter, 128 remained in pre-veterinary medicine for the full three quarters of the year. Thirteen were admitted into the veterinary school in the Fall of 1947.

Data on all of the psychological tests and grade-point averages were available for 185 pre-veterinary medicine students admitted as freshmen the Fall quarter of 1946. High-school rank and data on the psychological tests were available for 115 students.

For the 1945 pre-veterinary medicine students data were available on 50 of those listed as freshmen.

#### Analysis of data

The data were analyzed by statistical procedures in order to determine their use to counselors in the guidance of freshmen students planning to enter pre-veterinary medicine at Colorado Agricultural and Mechanical College. Since the only measurable criterion of success in pre-veterinary medicine is grade-point average, the data were analyzed to determine their relationship to grade-point average. An analysis of the data was made to derive a regression equation from which a predicted grade-point average would be calculated when the raw scores on the variables

(the A.C.E., the English, the Chemistry, and the Reading tests, and the high-school rank) were known.

Zero-order coefficients of correlation.--The predictive value of the different variables was about the same for each variable as shown by the correlations with grade-point average. The chemistry test was the best single predictor with a coefficient of correlation with grade-point average of .51. The A.C.E. and English tests were second with correlations of .50 with grade-point average. The Reading test with  $r = .48$  was fourth, and high-school rank with  $r = .46$  was the lowest single predictor of grade-point average.

The A.C.E., English, and Reading tests had the highest intercorrelations. The correlation between the A.C.E. and Reading test was .71, between the A.C.E. and English tests .69, and between Reading and English tests .73. The intercorrelations between these three variables show that they measure common factors and should add little toward the predictive efficiency of a combination of the variables when used together in a battery. High-school rank gave intercorrelations of .32 with the A.C.E., .31 with Reading, .36 with English, and .26 with the Chemistry test. The Chemistry test had a low correlation with other variables and, for that reason, should add to the predictive efficiency of a combination of the variables when included in a battery with them.

Multiple coefficients of correlation involving two variables.--Of the multiple coefficients of

correlation between grade-point average and a combination of two variables the highest multiple correlation, .61, was found between a combination of the Chemistry test and high-school rank. The multiple coefficients of correlation between a combination of two variables and grade-point average was found to be highest where high-school rank was included. The highest multiple coefficient of correlation not involving high-school rank was found to be .58 which was the correlation between a combination of the English and Chemistry tests with grade-point average.

Multiple coefficients of correlation involving three variables.--Multiple coefficients of corre-

lation computed between various combinations of three variables and grade-point average showed that a combination of the English and Chemistry tests and high-school rank, and a combination of the A.C.E., Chemistry test and high-school rank gave multiple coefficients of correlation of .64 with grade-point average. The multiple coefficient of correlation between a combination of the Reading and Chemistry tests and high-school rank, with grade-point average was found to be .63. All of the multiple coefficients of correlation between a combination of three variables and grade-point average were about the same. Again the multiple coefficients involving high-school rank were higher than those from which high-school rank was omitted.

The regression equation.--The regression equation based on the data for the 1946-47 group of freshmen in pre-veterinary medicine was as follows:

$$W = .0056x_4 + .0084x_5 + 1.21$$

In the equation, the two independent variables  $x_4$  (raw score on the English test) and  $x_5$  (raw score on the Chemistry test) were used to predict the grade-point average of freshmen students in pre-veterinary medicine.

Analysis of the scatter diagrams.--An analysis of the scatter diagrams from which the zero-order coefficients were obtained was made to determine how well the variables would predict the achievement of a grade-point average of at least 2.90, the approximate criterion of success in pre-veterinary medicine. This analysis failed to offer much in the way of prediction since many of those with low scores on the variables made high grade-point averages in pre-veterinary medicine. It was found, however, that the majority of those students that had high scores on the variables achieved a correspondingly high grade-point average.

The standard error of estimate.--The standard error of estimate for the predicted grade-point averages as calculated from the regression equation was .59 of a grade point.

The predictive efficiency of the regression equation.--The coefficient of correlation between predicted grade-point averages that were calculated from the

regression equation and achieved grade-point averages for the 1946-47 freshman pre-veterinary medicine group was .47. The coefficient of correlation between predicted grade-point averages calculated from the regression equation and achieved grade-point averages for the 1945-46 group of pre-veterinary medicine students was .40.

### Discussion

Various combinations of the five variables, the A.C.E., Reading, English, and Chemistry tests, and high-school rank could not be expected to yield high multiple coefficients of correlation with grades in pre-veterinary medicine since the zero-order coefficients of correlation were all low and the intercorrelations fairly high. Other investigators have found that combinations of variables beyond the number of three only slightly increase the obtained multiple coefficients of correlation. It was therefore decided that combinations of three variables would be the limits of the multiple coefficients computed.

The multiple coefficients of correlation found in this study are not as high as is desirable for prediction purposes, however, other investigators have found similar correlations between predictive criteria and achieved grade-point average.

Although combinations involving the use of high-school rank produced higher multiple coefficients than did

other combinations, it was decided that high-school rank would not be used. High-school rank is not recorded for many students at Colorado Agricultural and Mechanical College, and the various ways in which rank in the high-school graduating class is recorded give reason to doubt the validity of scores obtained for predictive purposes. The combination of the Chemistry test and English test with a multiple  $R = .58$  was only .06 lower than the highest multiple  $R$  for three variables, and .03 lower than the combination of the Chemistry test and high-school rank. It was decided that the combination of the English and Chemistry tests was the best and most practical combination to use in the regression equation.

The results of this study indicate that the data available to counselors, the scores achieved on the entrance examinations and high-school rank, do not offer a reliable means of predicting success for freshmen students that plan to enter the course in pre-veterinary medicine at Colorado Agricultural and Mechanical College. This study indicated that counselors may give some assurance of a fair degree of scholastic achievement to those that achieve a high score on the entrance examinations and have a high-school rank that is in the upper 75 per cent. The study failed to show a significantly high relationship between low scores on the variables and poor achievement in pre-veterinary medicine. Some students that achieved very low

scores on the entrance examinations achieved a high grade-point average. The majority of those that achieved high scores on the entrance examinations achieved a correspondingly high grade-point average in pre-veterinary medicine.

### Summary

This study was selected and carried out for the purpose of determining what relationships exist between success in pre-veterinary medicine and the data that are available to counselors in the guidance program of freshmen planning to enter pre-veterinary medicine at Colorado Agricultural and Mechanical College. Counselors need to know what these relationships are if they are to make use of the data that are available to them for counseling and guidance purposes.

The following data were collected on freshmen pre-veterinary medicine students of 1946-47:

1. Achieved grade-point average.

N = 185 (variable 1)

2. Raw score on the American Council on Education Psychological Examination.

N = 185 (variable 2)

3. Raw score on the Nelson-Denny Reading test.

N = 185 (variable 3)

4. Raw score on the Cooperative English test.

N = 185 (variable 4)

5. Raw score on the Iowa Chemistry test.

N = 185 (variable 5)

6. Rank in high-school graduating class.

N = 115 (variable 6)

The zero-order coefficients of correlation calculated between each of the variables and grade-point average (variable 1) were found to be as follows:

- |                   |                   |
|-------------------|-------------------|
| 1. $r_{12} = .50$ | 2. $r_{13} = .48$ |
| 3. $r_{14} = .50$ | 4. $r_{15} = .51$ |
| 5. $r_{16} = .46$ |                   |

The highest multiple coefficients of correlation for combinations of three variables with grade-point average were as follows:

- |                     |                     |
|---------------------|---------------------|
| 1. $R_1(245) = .59$ | 2. $R_1(256) = .64$ |
| 3. $R_1(365) = .63$ | 4. $R_1(456) = .64$ |

The highest multiple coefficients of correlations for combinations of two variables with grade-point average were as follows:

- |                    |                    |
|--------------------|--------------------|
| 1. $R_1(25) = .57$ | 2. $R_1(26) = .59$ |
| 3. $R_1(36) = .58$ | 4. $R_1(46) = .59$ |
| 5. $R_1(45) = .58$ | 6. $R_1(56) = .61$ |

The combination of the two variables, the English and Chemistry tests, was selected as the best and most economical battery to use in the calculation of the predicted grade-point averages. The following regression equation was developed:

$$W = .0056x_4 + .0084x_5 + 1.21$$

Where W = Predicted grade-point average

$x_4$  = English raw score, and

$x_5$  = Chemistry raw score.

The standard error of estimate for the predicted grade-point averages was found to be .59. The correlation between the predicted grade-point average and achieved grade-point average for the 1946-47 freshmen pre-veterinary medicine students was found to be .47. For the purpose of checking the results obtained from the regression equation the correlation between the predicted and achieved grade-point for the 1945-46 freshmen pre-veterinary medicine students was computed and found to be .40.

#### Summary and implications

The best single predictor of grade-point average for freshmen students of pre-veterinary medicine was the Chemistry test, and high-school rank was the poorest. Intercorrelations among the variables indicated that the A.C.E., Reading, and the English tests measured common factors and that the combination of the English and Chemistry tests was the best combination of two tests for predictive purposes. The addition of other variables did not increase the predictive value of the English and Chemistry combination enough to justify using more than two variables.

The regression equation did not predict actual grade-point averages well enough to be of much value to

counselors. Freshmen students of pre-veterinary medicine that achieved high scores on the variables may be given some assurance that they will achieve a correspondingly high grade-point average. However, students that did not achieve high scores on the variables did not achieve a correspondingly low grade-point average so that a critical score could be determined below which the student would have a slight possibility of achieving a grade-point average of 3.00, the criterion of success in pre-veterinary medicine.

Recommendations for further study

The regression equation developed on the scores obtained by the 1946-47 freshmen in pre-veterinary medicine was not as predictive as was expected. Another study, made at a later date, after the disturbing influences of World War II have diminished, may offer a better basis for prediction in pre-veterinary medicine.

There are other factors that influence the selection of those that are admitted into the veterinary school other than scholastic achievement in pre-veterinary medicine. A battery of tests including a good personality inventory, an interest inventory, and a study habits inventory should provide the basis for another study from which counselors of pre-veterinary medicine students may benefit.

A study to determine the relationship between

success in pre-veterinary medicine and success in the  
veterinary school would be of great benefit to counselors.

**T H E S I S**

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**Submitted by  
Lon Stephens**

**In partial fulfillment of the requirements  
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August 2 1948

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY  
SUPERVISION BY **LON STEPHENS**  
ENTITLED **PREDICTION OF SUCCESS IN PRE-VETERINARY  
MEDICINE**

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

MAJORING IN **GUIDANCE AND COUNSELING**

CREDITS **5**

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Dean of the Graduate School

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 great increase in the enrollment of colleges since the end of World War II has created many problems for the educational institutions of the United States. The Colorado Agricultural and Mechanical College has had such an increase in enrollment that some divisions of the college have found it necessary to limit drastically the number of students admitted.

The Division of Veterinary Medicine has increased the number of admissions made into that division to the full capacity of all available facilities. Sixty students are now admitted each year into that division, but this number is only a small percentage of those seeking admittance.

A student must spend three full quarters in pre-veterinary medicine before he becomes a candidate for admission into the school of veterinary medicine. Beginning with the school year of 1948-49, an additional year of pre-veterinary medicine will be required before the student becomes a candidate for admission into the school of veterinary medicine.

Before the great increase in enrollment came, the problem of such a large number of students entering the course in pre-veterinary medicine did not exist. The benefits given to veterans of World War II by the Federal government have made it possible for many to finance the course in veterinary medicine. Many have been cognizant of the shortage of veterinarians and the possibilities in that profession. The result has been an increase in the number of students attending Colorado Agricultural and Mechanical College with hopes of being accepted into the school of veterinary medicine. The competition for entrance into this department of the college is naturally keen because of the limited number of students accepted.

Of the students that enrolled in pre-veterinary medicine at Colorado Agricultural and Mechanical College during the Fall quarter of 1946, many changed majors during the year. However, of those remaining in pre-veterinary medicine for the three quarters of that school year, only a small percentage were admitted into the veterinary school.

Many undesirable conditions result when the student finds it necessary to give up the goal to which he aspires, after one, two, three, or more quarters of college work. Valuable time has been wasted. When a student pursues a goal that he cannot reach, there is a waste of his own economic resources as well as a waste of the resources of the college. When he withdraws from productive labor to

pursue a course in which he fails, social waste results. Failure of the student to gain admission into a division that requires a period of prerequisite work may result in a loss of self respect or personal worth.

A counseling problem exists in giving proper guidance to students that plan to enter the course in pre-veterinary medicine at Colorado Agricultural and Mechanical College because the number that can be accepted into the veterinary school is restricted and the number of students registering for pre-veterinary medicine is so large. The student and the college would benefit, if, through the guidance program at the time of entrance, those that will fail to do the caliber of college work required for entrance into the veterinary school could be directed into other departments of the college that do not require such a high scholastic achievement.

It has been the practice at Colorado Agricultural and Mechanical College to furnish counselors with data which may assist them in determining the potentialities of entering freshmen. These data consist of the scores of the student on psychological tests, which are administered to all entering freshmen, and his relative rank with other students in his high-school graduating class. The value of these data available to counselors depends largely upon the prognostic value for a particular college division. Since grades are largely the basis for selection of stu-

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### The problem

The problem of this study is: How can the data available to advisors be used most effectively in the counseling program of Colorado Agricultural and Mechanical College for the guidance of freshmen students planning to enter pre-veterinary medicine?

Analysis of the problem.--1. What relationship is there between scores achieved by freshmen students on the entrance examinations and grades achieved in pre-veterinary medicine?

2. What relationship is there between grades achieved during pre-veterinary medicine and high-school achievement, expressed in terms of rank in the high-school graduating class?

3. What factors or combination of factors considered are of optimum value in predicting grade-point average for students of pre-veterinary medicine?

4. Of the criteria retained, what weights should be assigned to secure optimum prediction of a grade-point average for students of pre-veterinary medicine?

5. How may the data be used by counselors in the guidance of freshmen students planning to enter pre-

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

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2. The standardized tests are administered to all entering students and the data made available to counselors at Colorado Agricultural and Mechanical College.

## Chapter II

## REVIEW OF LITERATURE

The literature that pertained to the prediction of college success contained many studies involving the use of data for the purpose of prediction. There was no literature available that dealt directly with the problem of predicting success in pre-veterinary medicine, the problem of this study. Since students in pre-veterinary medicine at Colorado Agricultural and Mechanical College are enrolled in the Division of Science and Arts, a review of the literature involving the use of data in predicting college success in general was made.

The literature concerning the prediction of college success is grouped under the following headings:

1. The use of data in prediction.
2. High-school achievement and scholastic achievement in college.
3. Mental tests and college scholarship.
4. Achievement examinations and college scholarship.
5. Other variables used in predicting college scholarship.
6. Combinations of predictive variables and

scholastic achievement in college.

7. The regression equation and its use in predicting college scholarship.

8. Factors affecting the prediction of college scholarship.

9. Prediction studies at Colorado Agricultural and Mechanical college.

The use of data  
in prediction

In 1927 Odell (27) stated that the small amount of selection that is made at college entrance undoubtedly results in many entering courses in which satisfactory work will not be done; that the college is therefore confronted with the need for providing educational guidance for entering students.

Crawford (5), 1930, had the following to say about the admittance of individual students into college:

The whole array of school credits, entrance examinations, psychological and other tests, evidences of good character, personal references, ratings, etc., is concerned with two questions: (1) Can this candidate probably maintain a satisfactory record in his college studies? (2) If so, is he in other respects also, the sort of individual whom we want in our student body? (5:125)

Crawford (5) also stated the following:

Increases in enrollment and the consequent limitations of numbers at many institutions have not only emphasized both these aspects of students' qualifications for admission, but have in some measures thrown them into contrast. If an institution finds it unwise to admit more than a certain

number of candidates, it must be able first of all, to justify its selections upon intellectual standards. At the same time within any substantial group of individuals not differing appreciably in scholastic promise, it has a right to select those who, by character, force of personality and possibilities for subsequent leadership, appear likely to make the greatest total contribution to its life.

Of these two bases of judgment, the scholastic, though no more important, is obviously the more objective. Since it also affords the more specifically defensible rating, this is also the one most generally applied in practice. (5:125)

Crawford (5) suggested that scholastic criteria should be made as reliable and comprehensive as possible and that methods of gauging intangible human qualities of the candidate awaited further refinement of objective scholastic criteria. He also suggested that, if we wish to select students on the basis of character and personality traits, we must first be reasonably sure of their academic potentialities.

Again, in 1930 Odell (28) contended that the data available seemed to justify the conclusion that those who enter college constitute a marked selection of all who graduate from high schools, but that among them are many individuals who are unable to carry the usual type of college work successfully.

Pressey (29), 1932, made a study in the prediction of first-quarter freshman grade-point average at Ohio State University and concluded:

Every effort should be made to discourage students whose prospects are poor, to persuade them to withdraw during the first few weeks and to suggest

constructively other lines of work into which they might go. These results indicate that such students are spending money to no good purpose, are taking up everyone's time and energy, and are headed for disappointment and failure. (29:389)

In 1934 Segel (33) made a study of the various methods of predicting college scholarship and concluded:

There have been at least three general types of tests used at least experimentally for determining admission to college and for the guidance of entering college students. All of these approaches have shown a definite predictive relationship between the test scores and later success in college. The three types of approaches are: (1) the testing of general aptitudes for college work through general aptitude tests (i.e.) intelligence tests; (2) the testing of achievement in specific subject matter studied in high school which is also found in the college curriculum; and (3) the testing of aptitudes for the attainment of scholarship in an individual college subject in which the student is assumed to have had no previous training. (33:11)

Segel also stated as follows:

If the objective of a college is to allow entrance to a large number of students with the expectation that a fair number of them will fail the predictive instruments need not be so highly predictive. However, if the aim of the college is to pick out only successful students to start with, the finest instruments for measuring aptitude available would not be entirely adequate. (33:25)

Feder (11), 1935, in an article on prediction, stated the following:

There are two phases of prediction in educational guidance. The first is the evaluation of the student's progress up to the moment of testing, and the prediction, in terms of such measurement, of how much farther he will progress in a stated interval of time. This is substantially the "I told you so" method. The second is the diagnosis, by means of appropriate tests, of a particular student's capabilities, difficulties, etc., and the attempt to guide his future study into those channels which

will yield him the greatest returns for effort expended. (11:597)

Leaf (20), 1940, made a study in prediction of college success and stated the following:

During the past two decades a large number of investigators have concerned themselves with the problem of the relationships between the students' marks in college and their marks in high school, and the scores on various examinations which were administered prior to their entrance into college. The main purpose of these investigations has been to find criteria for accurate prediction of the students' achievement in college. The studies have shown definitely that it is impossible to foretell the scholastic achievement of all the students in a given group, and that many cases of success or failure can not be discovered until the student has tried to do college work. (20:303)

High-school achievement  
and scholastic achievement  
in college

Many writers have found high-school achievement expressed either in terms of rank in the high-school graduating class or in terms of grades achieved in high school to be a good predictor of college scholarship.

Odell (27), 1927, found that most of the investigations of predicting scholastic success in college dealt with the making of predictions on the basis of high-school marks, college entrance examinations over high-school subjects and intelligence test scores. He stated as follows:

The results obtained by a large number of investigations may be summarized by saying that there is probably little difference in the accuracy of predictions based upon these three different criteria

and that most of the coefficients of correlation between any one of them and college marks may be expected to range from about .40 to .50 or perhaps higher; that combinations of these factors will often yield correlations of .60 or above; and that if measures of study and other relevant habits are included this figure can be raised appreciably. (27:52)

Crawford (5), 1930, made a study of the high schools that contribute regularly to the freshman class at Yale University and concluded:

If a student, for instance stands 25 in a class of 60 at a first-rate preparatory school characterized by rigorous standards for admission to its lower forms and prompt elimination of boys whose performance is unsatisfactory, the probabilities are that this individual is distinctly superior in both performance and promise to one who ranks 250 in a class of 600 in a large high school. (5:128)

In 1930 Odell (28) made a study of approximately 2,000 college students whose high-school averages were available and found the correlation between complete averages in college and high-school averages to be .54. Odell found that almost 100 did not remain in college long enough to have any grades recorded. Of the group, 1677 completed the freshman year and 486 graduated in four years. The relation between high-school average and persistence in college was about the same as that between intelligence test scores and persistence. High-school average ranked next to freshman averages in predicting success in the last three years of college.

Segel (33), 1934, found a correlation of .55 between high-school marks and general college scholarship.

He stated that one reason for the low correlation between high-school marks and college marks is that the curricula of the schools are not very closely allied.

Wagner (39) concluded in 1934 that past achievement was the best indicator of college achievement. She found that most of the studies contained in her summary indicated that the high-school record was the best predictor of college success.

Schmitz (32), 1937, found that college grades at St. Benedicts' College correlated .64 with high-school marks.

Quaid (30), in a study made at Phillips University in 1938, found high-school average marks to be the second best predictor of first semester grade-point average for college freshmen. Average high-school marks correlated .516, the Ohio State University Psychological Examination scores .522, and American Council test scores .408.

Hepner (16), 1939, reported a study of 600 freshmen who had completed one year of college work. He found a correlation of .524 between average high-school marks and average college marks for the freshman year.

In a study made by Dressel (8), 1939, 15 high schools that contributed regularly to the freshman class at Michigan State College were studied to determine the possibility of ranking high schools on the basis of the college success of their graduates and to determine if the

ranking was stable enough to be used in predicting the college success of high-school graduates. It was found that groups of students from different high schools differed significantly in their high-school and college grades. The correlation between all high-school grades and college grades was found to be .52. The correlation between high-school grades and college grades within high schools was found to be .59.

Cole (2), 1940, found that correlations between high-school marks and college grades varied with different studies from .15 to .65 and concluded that the great variability was due to the tendency of a teacher to assign grades within whatever range of abilities that her particular group of students possessed.

Douglass (6), in a study of prediction of success in the Medical School of the University of Minnesota in 1942, found that average high-school marks correlated .24 with first-year medical honor points.

Durflinger (10), 1943, made a survey of the work that had been done in the prediction of college success and reported that, when available, high-school grades are frequently used as predictive indices. He reported that high-school grades had been found as accurate a basis for predicting college scholarship as any other single criterion. From his study Durflinger found sufficient basis for concluding that the correlations between college scholarship

and high-school scholarship will vary from .50 to .60 with a median of about .55.

High-school rank and college success.--The rank of the student in his high-school graduating class has been found to be a good predictor of college success. Tuttle (38) made a study at the University of Illinois in 1935 and found that high-school rank for students above the 75th percentile and below the 25th percentile was a fair predictor of college success. For those in the middle group predictions were not as accurate.

In 1937 Drake and Henmon (7) reported on a study made at the University of Wisconsin of 618 letters and science freshmen. High-school rank centiles and freshman grade-point averages correlated .60 which was higher than correlations between American Council centiles or Cooperative English centiles with grade-point averages. Any combination of the three variables containing high-school rank was more effective than any other combination.

After making a study of the use of high-school rank for predicting college success at Pennsylvania State College, Hoffman (17), 1937, concluded:

Rank in secondary school graduating classes has been compared with college success in more than a score of studies sent out by this office alone, to say nothing of those made elsewhere. The fact remains, however, that high rank in some schools does not predict college success, and therefore the Pennsylvania State College checks the rank of the applicant by comparing it with the work done by those similarly ranked who come from the same school,

during the four preceding freshman years. If those previously admitted from the same school had an average rank somewhere in the upper six tenths of the freshman class the applicant is admitted on certificate; if at a lower level admission is granted after the passing of some type of college aptitude test. (17:829)

Butsch (1), 1939, made a study in prediction at Marquette University and reported that high-school rank and grade-point average correlated .471 for the College of Business Administration, .553 for the College of Engineering, .559 for the College of Liberal Arts, and .531 for the College of Journalism.

From a study of 7,006 entering freshmen at the University of Missouri, Seyler (34) reported in 1939 that he found a percentile rank of 58 in the high-school graduating class necessary to predict a probable passing average the freshman year in college. He found a definite positive relationship between rank in the high-school graduating class and freshman scholastic achievement.

Cole (2), 1940, reported that high-school marks could be used for predicting college grades if they were expressed in terms of rank instead of letter grades.

#### Mental tests and college scholarship

In 1927 Odell (27) made a study of the work that had been done in attempting to predict the scholastic success of college students by means of intelligence test scores and concluded that a range of .40 or .50 may usually be expected between scores on an intelligence test and

freshman marks. He found this to be about the same correlation as was found between high-school marks and marks received during the freshman year in college, and slightly higher than those given by entrance examinations covering high-school subjects. He made the following comment:

Coefficients of correlation of the sizes usually found that are from .40 to .50 or even .60 indicate that the corresponding predictions of freshmen marks are not a great deal better than pure guess. (27:53)

Crane (4), 1927, in a study made at Bryn Mawr College, found correlations having a central tendency of .32 between the Thurstone Intelligence Test scores and academic achievement. From her study she concluded that, even though the correlations between academic marks and psychological tests were low, they were useful in selecting those that would most likely be in the upper and lower limits of college academic success.

Toll (37), 1928, described the results obtained from scholastic aptitude tests, or intelligence tests, administered to entering freshmen at Amherst College for experimental purposes only. At the end of the freshman year the correlations between test scores and college grades of men who had completed the freshman year were computed. During the five year period over which the study was made, the Otis Self-Administering Test, Higher Examination, correlated .19 to .38 with the freshman year grade-point average. Other tests such as the Army Alpha; Terman Group;

Smith College Information (1926 Edition); C.H.T. (a sentence completion and vocabulary test; and the Amherst Test (a revised form of the C.H.T.) were administered and resulted in correlations of .23 to .38 with freshman grade-point average. Toll stated the following:

In fairness to the tests it must, of course, always be remembered that the correlations of a perfect "intelligence" test with college grades would be badly lowered by the fact already noted, that some really competent men are indifferent towards their academic work. It would be lowered also by different instructors; and by a tendency in some instructors to assign grades largely in proportion to the mere industry exhibited by the students; and by a tendency in others to assign grades more or less in accordance with their likes and dislikes. (37:526)

In 1930 Odell (28) found that those making high scores on intelligence tests tended to remain in college while those making low scores on intelligence tests tended to be the first to drop out.

Freeman (12) questioned the use of mental tests for predicting the grade of work attained in college. In 1931 he stated as follows:

All these investigations of the prediction of college scholarship have yielded interesting and valuable data; but none, it appears, has dealt with the problem which, to the writer, seems most fundamental; namely, how well do the tests of mental ability predict academic survival, regardless of marks? If our results are typical, it must be said that the mental tests are inadequate as selective instruments at the college level, just as any other single criterion is inadequate. Yet they have a contribution to make, and on that basis their employment is justifiable. (12:113)

In 1934 Segel (33) concluded that the earliest

studies of the prognosis of college success used psychological tests and that not much relationship was found between the results of these tests and college success. He found the correlation between general mental tests and college scholarship to be .44, and the correlation between persistence in college and the Ohio psychological examination to be only .19.

Mills (25) made a study of 101 first-quarter freshmen that failed to pass the minimum number of hours at the University of Colorado in the Fall quarter of 1929. From this study, made in 1934, it was found that 47 were in the lowest 25 per cent on the American Psychological Examination; 32 were in the third or next to lowest quartile; 14 were in the second or next to highest quartile; eight were among those in the highest 25 per cent on the psychological test.

In a study made by Schmitz (32) at St. Benedicts' College in 1937, the correlation between the American Council on Education Psychological Examination and grade-point average was found to be .58. Drake and Henmon (7), the same year, found a correlation of .66 between the American Council centile scores and freshman grade-point average.

In a study of 140 freshmen at Phillips University in 1938, Quaid (30) found that the Ohio State University Psychological Examination scores correlated .522 with the

grade-point average of college freshmen. The correlation coefficient obtained between the American Council Test scores and first semester scholarship was found by Quaid to be only .408.

Manning (24), 1938, reported a correlation of .67 between the American Council on Education Psychological Examination and first-year college grades.

In a study made by Langhorne (19), 1939, at Emory University, a significant relationship was found between the average percentile rank on the American Council on Education Psychological Examination and the length of time the students were enrolled in college. Rigg (31), 1939, at Oklahoma A and M College found a correlation of .52 between scores made on the American Council on Education Psychological Examination and first-semester grade-point average of freshmen.

Butsch (1) in a study made at Marquette University in 1939, found the correlation between the Thurstone Psychological Examination and grade-point averages in the College of Business to be .469, the College of Engineering .519, the College of Journalism .462, and the College of Liberal Arts .525.

DuBois (9) in his study at the University of New Mexico in 1939, found a correlation of .44 between the first-semester grade-point average and scores made on the American Council on Education Psychological Examination.

Durflinger (10), 1943, made a summary of a number of studies reported by earlier investigators and concluded as follows:

The conclusion may be drawn that intelligence tests are used in almost every attempt to predict college success whether alone or with other measures. In most schools the correlation between intelligence and college grades is between .40 and .50. Intelligence tests vary among themselves in their ability to predict college grades. (10:71)

The median correlation between intelligence test scores and college scholarship reported by Durflinger (10) in his summary, Table 1, was .52.

Table 1.--SUMMARIES OF CORRELATION BETWEEN INTELLIGENCE AND COLLEGE SCHOLARSHIP. From Durflinger (10:71)

Author	Date	Number	Median or Mean
H. R. Douglass	1931	160	.45 Median
L. B. Kinney	1932	442	.44 Mean .44 Median
David Segel	1934	100	.44 Median
Mazie E. Wagner	1934	39	.40 - .50 Median
L. W. Durflinger	1942	47	.52 Median

Table 2, from Durflinger (10), shows the correlations that he reported between various psychological tests and college scholarship in his summary made in 1943.

Table 2.--CORRELATIONS BETWEEN PSYCHOLOGICAL TESTS AND COLLEGE SCHOLARSHIP. From Durflinger (10:70)

Investigator	Institution	Tests	Criterion grades	r
Butsch	Marquette U.	Thurstone	First semester	.46, .47
				.49, .49
				.52, .53
Gladfelter	Temple U.	A.C.E.	First year	.52, .57
				.59
Hepner	San Diego U.	A.C.E.	First year	.41
Manning	Ursinus U.	Otis S-A	First year	.50, .67
Morris	Albany Jr. College	Ohio State	First semester	.43
Quaid	Phillips U.	Ohio State	First year	.70
Quaid	Phillips U.	A.C.E.	First year	.66

Durflinger (10), 1943, gave the following reasons why studies before 1934 found the median correlation between intelligence tests and college grades to be .45 while the studies since 1934 found a median correlation of .52.

1. Newer intelligence tests, being designed primarily for college students, may measure more of the factors present in scholastic achievement than did earlier tests.

2. College instructors may be using the results of intelligence tests to assist in arriving at the grades

awarded to students.

3. College marks may be based upon course examinations and requirements which have a closer relationship with intelligence than was the case in 1934.

Achievement examinations  
and college scholarship

Achievement examinations have been found by some investigators to be as good a predictor of college success as psychological tests. Condit (3), 1929, made a study at Colorado State College of Education and found that achievement test scores and first-year grades correlated .49.

Segel (33), 1934, reported a correlation of .545 between general achievement tests and college scholarship. He found that an achievement test in a specific subject had a greater predictive value for individual college subjects than did a scholastic aptitude test. Several such tests of individual subjects predicted general college scholarship better than one scholastic aptitude test. Segel also found that general achievement tests at the end of the high-school course are more prognostic of general college scholarship than general mental tests, the correlation being .535.

Feder (11), 1935, made a study of 324 Liberal Arts students and found that the Iowa Qualifying Examinations correlated .57 with the first-year grade-point average of college students.

Leaf (20), 1940, reported a correlation of .63 between the Iowa High School Content Examination and college freshman grade-point average.

In 1942 Livingood (21) concluded that a battery of standardized tests administered to college freshmen with a derived aptitude index can serve to indicate probable scholastic achievement, particularly during the first year of college.

Durflinger (10), 1943, made a summary of some of the correlations between content examinations and college scholarship that had been found to date. His summary reported a median correlation of .475 between correlations found in studies he investigated and college scholarship.

Table 3.--SUMMARIES OF CORRELATIONS BETWEEN CONTENT EXAMINATIONS AND COLLEGE SCHOLARSHIPS. From Durflinger (10:73)

Author	Date	Number of studies	Median
Douglass	1931	67	.55
Segel	1934	13	.545
Wagner	1934	88	.56
Durflinger	1942	20	.475

Durflinger (10) concluded that the difference between his summary and the three earlier summaries was probably due to the small number of studies summarized, or that the students may not have been prepared in one or two

parts of the content examinations. He concluded that a two-hour achievement test will give a score that is as predictive of college scholarship as the more laborious method of accumulating the high-school record

Other variables used in predicting college scholarship

Nelson (26), 1930, in a report on the testing program at Iowa State Teachers College stated that 71 per cent of those that failed in some of their courses made scores on the Nelson-Denny Reading test that were in the lowest 50 per cent of all the scores on the test.

In 1932 Pressey (29) reported on a study made at Ohio State University in which a series of tests in reading, English, mathematics, history, language, and intelligence were given to entering freshmen. A week after the beginning of the quarter Pressey went through the list of students that had taken the tests and marked in red those that made an average percentile score on all the tests of 85 or above and classed the group as "very promising". Those that made an average percentile of 15 or below were marked in blue and classed as "unpromising". Remedial reading was given to 62 of the lower group; so they were considered separately. At the end of the quarter the grades in all subjects (not counting physical education, military, and survey courses) were found. Twenty-three students had withdrawn, or were incomplete, or their grades could not be

found. There remained a total of 156 in the "unpromising" group, 62 in the group that had received remedial reading, and 163 in the "very promising" group. In the "very promising" group four made less than a 2.00 average, 50 an average of 2.00 to 2.99, 90 an average of 3.00 to 3.99, and 19 an average of 4.00. In the "unpromising" group that did not receive remedial reading 131 made less than a 2.00 average, 23 an average of 2.00 to 2.99, and two an average of 3.00 to 3.40. In the "unpromising" group that was given remedial reading 47 made an average of less than 2.00, and 14 an average of 2.00 to 2.99.

Segel (33), 1934, stated that college guidance practices can be improved by the use of test batteries in place of single tests and that the addition of tests to one or more already in use will improve the result if the tests added have a low correlation with the tests already being used.

Drake and Henmon (7), 1937, reported a correlation of .54 between the Cooperative English test centiles and freshman grade-point averages. They also reported a correlation of .48 between the Henmon-Nelson College centiles and freshman grade-point averages.

Gladfelter (14), 1937, reported the Cooperative English test to be as valuable as either high-school rank or the American Council on Education Psychological Examination for predicting college success. He found a correla-

tion of .57 between the Cooperative English test scores and scholastic achievement.

Smith (35), 1945, stated that it is too risky to advise a student on the basis of a single measure such as an aptitude percentile score or an intelligence quotient, and that many things can happen during a single examination partially to invalidate such a score. He stated that several measures should give us greater assurance in our guidance services to the student.

Combinations of predictive variables and scholastic achievement in college

The use of several variables combined to form a multiple coefficient of correlation has been reported in various studies. Odell (27), 1927, stated that a combination of scores based upon a reliable intelligence test, the best type of entrance examinations over high-school subjects, high-school marks, and ratings of study habits would result in a multiple correlation of .75 or .80 with college scholarship.

Segel (33), 1934, reported that a series of studies found multiple coefficients of correlation between combinations of variables and college scholarship that ranged from .56 to .81.

Drake and Henmon (7), 1937, reported a study of 618 freshmen at the University of Wisconsin in which multiple coefficients of correlation between various combina-

tions of high-school rank, American Council test centiles, Henmon-Nelson college centiles, and Cooperative English test centiles with grade-point average were found to range from .58 to .69 using three variables and .67 to .70 using more than three variables. They concluded the following:

It appears that we have reached a limit in reducing the error of estimate by using the available measures and that for practical purposes a combination of two independent variables is as desirable as combinations containing more variables. (7:192)

Quaid (30), 1938, found correlations of .59, .605, and .621 between combinations of the Ohio State University Psychological Examination, high-school average marks, American Council test scores, and first-semester college freshmen marks.

From a summary of studies made in multiple correlation Durflinger (10), 1943, concluded that (1) multiple correlation coefficients are rarely higher than .80 regardless of the variables used, (2) an intelligence test, a good achievement test, and high-school grade averages together usually bring the highest multiple coefficients, and (3) the median multiple coefficient as found in the summaries was between .60 and .70.

McClanahan (22), 1947, reported the following multiple coefficients found by different investigators. Table 4.

Table 4.--MULTIPLE CORRELATION COEFFICIENTS REPORTED BY  
DIFFERENT INVESTIGATORS. From McClanahan (22:29)

Predicted variables	Multiple r	Reporter
High-school rank, intelligence, and High School Content Test	.59	Butsch
Intelligence, high-school rank, college aptitude test, and freshman English	.83	Root
T.C.P.A. intelligence, elementary and English tests	men .54 women .55	Durflinger
High-school marks, Ohio State University Intelligence Test, and study performance test.	.75	Hartson
College Entrance Board tests, high-school record, intelligence test, and age.	.74	Crawford
American Council on Education Psychological Examination, high-school average, English test	.69	Gladfelter
High-school scholarship, college aptitude test, and achievement test battery	.69	Williamson and Bordin
High-school rank, American Council on Education Psychological Examina- tion, Iowa Chemistry Aptitude test	.74	Gould

The regression equation  
and its use in predicting  
college scholarship

Various investigators have reported the use of a regression equation derived from statistical treatment of combinations of variables to predict the grades of individual students.

Hotelling (18), 1935, suggested that in predicting a non-measurable variable by means of a second set of observable data, such as the examination and test grades recorded for applicants for college admission, no single regression equation can provide a fully adequate solution. Several regression equations must be used to give a proper picture.

Drake and Henmon (7), 1937, derived from scores of entering freshmen at the University of Wisconsin in 1933 equations to predict the grade-point average for the entering freshmen of 1934. The equations were as follows:

$$\bar{X} = 1.6525A + .9278C - .4369$$

$$\bar{X} = 1.4630A + 1.4118B - .6756$$

$\bar{X}$  = Predicted grade-point average.

A = High-school rank expressed in centiles.

B = American Council College centiles.

C = Cooperative English test centiles.

Using the regression equation Quaid (30), 1938, found the average difference between predicted marks and achieved marks of first-semester freshmen at Ohio State University ranged from .314 of a grade point to .555 of a grade point. Butsch (1), 1939, reported the following:

Regression equations based on previous classes, when applied to newly enrolled freshmen, result in predictions which are, on the average, within 0.3 grade-point of the actual grade earned. (1:420)

Leaf (20), 1940, made a comparison of scores

achieved on the American Council on Education Psychological Examination, the Iowa English Aptitude Examination, the Iowa High School Content Examination and high-school marks, with college marks the freshman year. He used 97 students in his study. Using a regression equation he found three instances in which there was no difference in the predicted mark and achieved mark. The largest difference between the predicted mark and achieved mark was 1.12 of a letter mark. The median of the difference was .26, and the standard error of estimate .44. The coefficient of correlation between predicted marks and achieved marks was .77.

Factors affecting the prediction of college scholarship

Many investigators have reported factors that tend to detract from the predictive value of data used in the prediction of college scholarship. Crawford (5), 1930, suggested that, in arriving at predictions of the probable scholastic success of college students, every institution must carefully study its own particular student body. He also stated the following:

There seem to be several factors interrelated to some degree but yet essentially different which determine scholastic attainment in the freshman year at Yale. The most important of these are the individual's inherent or potential ability, the opportunity he has had for its development through schooling and preparation for examinations, and his seriousness of purpose or motivation. (5:127)

Segel (33), 1934, stated that no matter how

perfect our instruments of prognosis may be factors outside our control will nullify some of our recommendations.

Feder (11), 1935, concluded as follows:

We can never reach, and, in fact, should never aspire to reach 100 per cent accuracy in educational prediction. Such an end is impossible of achievement because, among other reasons: (1) Our measuring instruments do not have perfect validity and reliability; (2) we have no way of controlling or directly evaluating the effects of motivation; (3) there are subtle personality factors characteristic of testees which preclude the possibility of achieving "true" measures at each tested performance. Furthermore, such a goal is undesirable because it would result in a complete static system of education. (11:597)

Williamson (40), 1937, stated that certain changes in educational and personnel practices and in grading provide a partial explanation for the decrease in the coefficients of correlation between various criteria and scholastic success in college. He suggested that these factors make it increasingly difficult to maintain accuracy of prediction.

Rigg (31), 1939, stated that several factors other than mastery of subject matter are important in securing high college grades. He suggested that doing what the assignment requires, doing work on time, giving the teacher back his own ideas, presenting the work the way the teacher wants it, using diplomacy, and regularity of attendance, are factors influencing the achievement of high grades.

Butsch (1), made a study at Marquette University

in 1939 and found that the correlations between college scholarship and scores achieved on entrance examinations varied so much for the various departments of the college that it was necessary to make studies of the tests in each department.

Studies in prediction  
at Colorado Agricultural  
and Mechanical College

To date three studies in the prediction of college success have been made at Colorado Agricultural and Mechanical College. Gould (15), 1944, made a study in the prediction of first-semester grade-point average. In 1947 McClanahan (22) made a study in the use of standardized tests in counseling freshmen in the engineering division. Stinson (36), 1947, made a study of the success of the non-high-school graduate.

Gould (15), 1944, studied the prediction of first-semester grade-point average using five variables. Zero-order coefficients of correlation between each variable and every other variable were computed, Table 5. The correlation between the American Council on Education Psychological Examination and first-semester grade-point average was .6338, the highest found. The Iowa Placement Examination, Mathematics Aptitude test resulted in a correlation of .5256, the lowest correlation found with first-semester grade-point average. Intercorrelations between the variables indicated that the American Council on Education

Psychological Examination and the Cooperative English test measured much the same factor, as did the American Council on Education Psychological Examination and the Iowa Mathematics Aptitude test.

Table 5.--ZERO ORDER COEFFICIENTS OF CORRELATION BETWEEN EACH VARIABLE AND ALL OTHER VARIABLES. From Gould (15:31)

	A.C.E. (2)	H.S.R. (3)	Chemistry (4)	English (5)	Mathe- matics (6)
Grade Point Average (1)	.6338	.6056	.5890	.5588	.5256
2		.4723	.7167	.7969	.7729
3			.4001	.4960	.4027
4				.5371	.7089
5					.4735

Gould found that the multiple coefficient of correlation between the first-semester grade-point average and scores on the American Council on Education Psychological Examination, high-school rank, and the Iowa Chemistry Aptitude test was .74. He found this combination to be the strongest and most economical.

The regression equation computed by Gould (15:35), 1943, to predict first-semester grade-point averages was as follows:

$$\bar{Y} = .004419x_2 + .0169x_3 + .18068x_4 - 1.1147$$

In this equation  $\bar{X}$ , the first-semester grade-point was predicted from  $x_2$ , the American Council on Education Psychological Examination raw score,  $x_3$ , the Iowa Chemistry Aptitude test raw score, and  $x_4$ , the rank of the student in his graduating class.

Gould (15) stated that the regression equation could be used by counselors for the following:

1. Assist the student to choose a curriculum appropriate to his abilities.

2. Single out for special consideration weak students who might be advised to take a limited program.

3. Make a more objective judgment of the amount of spread between ability and achievement.

4. Differentiate under-achievers who will need to be goaded into further effort from those who, already achieving at maximum capacity, might be discouraged by further reproof.

5. Recommend to the Student Personnel Division for diagnosis and treatment, cases of serious discrepancy between ability and achievement.

The Student Personnel Division should find the device useful in the following guidance functions:

1. As an aid in diagnosing cases of unwise vocational choice.

2. As an indicator of a maladjustment to college life.

3. As a basis for restriction of a student's activity program. (15:43-4)

McClanahan (22), 1947, predicted success in the Division of Engineering at Colorado Agricultural and Mechanical College. The variables studied were the American Council on Education Psychological Examination, the Iowa

Chemistry Aptitude test, the Cooperative English test, the Nelson-Denny Reading test, and the rank of the student in high-school graduating class. Of the zero-order coefficients of correlation that were computed the Iowa Chemistry Aptitude test was the highest with a correlation of .652 with the first-year grade-point average, Table 6. Inter-correlations between the variables indicated that the Cooperative English test, the American Council on Education Psychological Examination, and the Nelson-Denny Reading test measured common factors.

Table 6.--ZERO-ORDER COEFFICIENTS OF CORRELATION BETWEEN EACH VARIABLE AND VARIOUS SINGLE VARIABLES. From McClanahan (22:46)

Measuring device	(2)	(3)	(4)	(5)	(6)
(1)	.583	.652	.495	.648	.359
(2)		.157	.708	.777	.487
(3)			.496	.543	.173
(4)				.807	.308
(5)					.297

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

Of the multiple coefficients of correlation computed by McClanahan the correlation of .814 between the

first-year grade-point average and raw scores on the Cooperative English test and Iowa Chemistry Aptitude test was selected as the most efficient and best predictor of first-year grade-point average.

The regression equation computed by McClanahan (22:52) from his data was as follows:

$$W = .008X_2 + .016X_3 - .16$$

In this equation the two independent variables  $X_2$  (score on the Cooperative English test) and  $X_3$  (score on the Iowa Chemistry Aptitude test) were used to predict the first-year grade-point average in the Division of Engineering. McClanahan found the standard error of estimate to be .45 and the correlation between the predicted and achieved grade-point averages to be .676.

Stinson (36), 1947, in his study of the college success of non-high-school graduates compared the scores made on the General Educational Development test, the American Council on Education Psychological Examination, the Cooperative English test, the Iowa Chemistry Aptitude test, and the Nelson-Denny Reading test, with first-quarter grade-point averages achieved by 30 non-high-school graduates. The best predictor was found to be the General Educational Development test with a correlation of .591 with first-quarter grade-point average. A correlation of -.027 was found between the Iowa Chemistry Aptitude test and first-quarter grade-point average, Table 7.

Table 7.--RELATIONSHIP BETWEEN FIRST-QUARTER GRADE-POINT AVERAGE, GENERAL EDUCATIONAL DEVELOPMENT TEST SCORES, AND COLLEGE ENTRANCE EXAMINATION SCORES OF NON-HIGH-SCHOOL-GRADUATES AT COLORADO AGRICULTURAL AND MECHANICAL COLLEGE, 1946-47. From Stinson (36:76)

Test	G.P.A.	A.C.E.	English	Chemistry	Reading
GED 1	.400				
GED 2	.485				
GED 3	.272				
GED 4	.463				
GED 5	.218				
Total GED	.591	.814	.454	.413	.841
A.C.E.	.354		.442	.500	.677
English	.423			.430	.292
Chemistry	-.027				.346
Reading	.464				

### Summary

Investigators in the field of prediction seemed to agree that the positive correlation between college scholarship and general aptitude tests, achievement in high school, high-school rank, and various special aptitude tests will range from .40 to .60. Combinations of the above variables result in higher correlations than do the single variables.

Studies involving the use of a regression equation indicated that a fair degree of accuracy can be made

in predicting college scholarship by that method, but that the accuracy of prediction will vary from college to college and within departments of the same college.

The review of literature indicated that there are many factors that tend to detract from the predictive value of data. The findings of studies made at Colorado Agricultural and Mechanical College tend to agree with the findings at other institutions.

### Chapter III

#### METHODS AND MATERIALS

Those freshmen students that entered Colorado Agricultural and Mechanical College for the Fall quarter of 1946-47 in pre-veterinary medicine were selected as the population for this study, since this was the first large group that produced the problem of giving proper guidance to students planning to enter this course.

Data for this study were collected from the files of the office of student affairs and the office of the college registrar. The office of the registrar provided the scholastic record of each freshman student that entered pre-veterinary medicine the Fall quarter of 1946-47. The office of student affairs was the source of the following data that were furnished to counselors:

1. Raw scores made by the students on the Iowa Placement Examination, Series CA 1, revised, A, Chemistry Aptitude Test.
2. Raw scores made by the students on the Cooperative English Test, Form PM.
3. Raw scores made by the students on the American Council on Education Psychological Examination for

High School Seniors and College Freshmen, 1943 Edition.

4. Raw scores made by the students on the Nelson-Denny Reading Test for Colleges and Senior High Schools.

5. The position of the student in his high-school graduating class.

Hereafter the above will be referred to as:

1. the Chemistry test, 2. the English test, 3. The A.C.E. test, 4. the Reading test, and 5. high-school rank.

The data listed above were collected for freshmen pre-veterinary students of 1945 for the purpose of checking the results of the study.

The office of the college registrar supplied the grade-point average by quarters, and the total grade-point average for the year for each student.

The high-school rank of each student is recorded in his file in terms of the quartile in which he stood in his high-school graduating class, or in terms of the relative position from the top of his graduating class and the number in his graduating class.

The high-school rank of each student was translated into a percentage rank as follows:

1. Students who were ranked according to the quartile in which they stood in their graduating class were assigned a percentage rank equal to the mid-point of their

quartile rank. The first one-fourth was assigned a percentage rank of 88, the second one-fourth a percentage rank of 63, the third one-fourth a percentage rank of 38, and the fourth one-fourth a percentage rank of 13.

2. The high-school rank of a student who was ranked in terms of the relative position from the top of his graduating class and the number in his graduating class was translated into a percentage rank by dividing the position from the top of the graduating class by the number in the graduating class; subtracting this quotient from one and multiplying by one hundred. For example: For a student ranked as 10 in a class of 30, the 10 was divided by 30 to obtain  $.33 \frac{1}{3}$ . The  $.33 \frac{1}{3}$  was subtracted from 1.00 to obtain  $.66 \frac{2}{3}$ . The  $.66 \frac{2}{3}$  was multiplied by 100 and rounded off to secure a percentage rank of 67.

#### Groups studied

A list of all students registered in pre-veterinary medicine during the school year 1946-47 was made up from the student body lists for each quarter 1/. To determine those that had no previous college training it was necessary to check the application for admission to Colorado Agricultural and Mechanical College and the registration blank for the first quarter for each student listed in pre-veterinary medicine. The same procedure was follow-

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1/ See Appendix A for enrollment in pre-veterinary medicine 1946-47

ed to obtain the list of all pre-veterinary medicine students for 1945-46 2/.

Data for the freshmen entering the course in pre-veterinary medicine were studied to determine the relationships between these data and the criterion of success in pre-veterinary medicine as based on the number of quarters the student remained in the course and grades made.

Of the 199 freshmen that entered in pre-veterinary medicine the Fall quarter of 1946-47, 13 withdrew from college before the quarter ended. Eight registered in another department of the college at the beginning of the Winter quarter and 13 withdrew from college that quarter. The Spring quarter, 16 registered in a different course and 21 withdrew from college. Of the 199 freshmen that entered the course in the Fall quarter, 128 remained in pre-veterinary medicine for the full three quarters of the year. Thirteen were admitted into the veterinary school in the Fall of 1947.

Data on all of the psychological tests and grade point averages were available for 185 pre-veterinary medicine students admitted as freshmen the Fall quarter of 1946 3/. High-school rank and data on the psychological

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2/ See Appendix C for enrollment in pre-veterinary medicine 1945-46

3/ See Appendix B for variates of the 1946-47 freshmen pre-veterinary medicine students

tests were available for 115 students.

For the 1945 pre-veterinary medicine students data were available on fifty of those listed as freshmen 4/.

The office of the college registrar supplied the grade-point averages used. The grade-point average by quarters and the total grade-point average for the year are available for each freshman student in pre-veterinary medicine. Grade-point average was computed as follows:

1. Weights were assigned each letter grade so that an "A" equaled 4, a "B" equaled 3, a "C" equaled 2, a "D" equaled 1, and an "F" equaled 0. "WF" (withdrawing failure), "I" (incomplete), and "E" (condition) were counted as "F". "WP (withdrawing passing) was disregarded.

2. By multiplying the number of credits by the weight assigned the letter grade, the grade-points were computed for each course.

3. The grade-point average for each quarter was computed by dividing the sum of the grade-points earned during the quarter by the total number of hours for which registered.

4. The sum of the grade-point average for each quarter divided by three gave the grade-point average

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4/ See Appendix D for variates of the 1945-46 freshmen pre-veterinary medicine students

for the pre-veterinary year.

The only criterion of success in pre-veterinary medicine that was measurable was grade-point average for the three quarters of 1946-47. A grade-point average of 3.0 was the lower limit of those considered for possible entrance into the school of veterinary medicine.

Chapter IV  
ANALYSIS OF DATA

For the purpose of determining the relationship between grade-point average and data available to counselors, data were gathered from the files in the office of student affairs and in the office of the registrar at Colorado Agricultural and Mechanical College. These data included scores achieved by freshmen pre-veterinary medicine students who took the entrance examinations (the A.C.E., the English, the Chemistry, and the Reading tests), rank of student in his high-school graduating class, and the letter grades and credits earned by all students.

These data were collected for the freshmen pre-veterinary medicine students of 1945 1/ to test the predictive efficiency of the regression equation based on the 1946 2/ population of freshmen pre-veterinary medicine students enrolled at Colorado Agricultural and Mechanical College. They were analyzed by statistical procedures in

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1/ See Appendix D for variates used in the study of the 1945-46 freshmen pre-veterinary medicine students.

2/ See Appendix B for variates used in the study of the 1946-47 freshmen pre-veterinary medicine students.

order to determine their use to counselors in the guidance of freshmen students planning to enter pre-veterinary medicine at Colorado Agricultural and Mechanical College. Since the only measureable criterion of success in pre-veterinary medicine is grade-point average, the data were analyzed to determine their relationship to grade-point average. An analysis of the data was made to derive a regression equation from which a predicted grade-point average would be calculated when the raw scores on the variables (the A.C.E., the English, the Chemistry, and the Reading tests, and the high-school rank) were known.

#### Statistical methods

Statistical methods used in studying raw data from the 1946 population in order to determine the relationship of the variables (the A.C.E., the English, the Chemistry, and Reading tests, and high-school rank) with achieved grade-point averages for freshmen students of pre-veterinary medicine were as follows:

1. Zero-order coefficients of correlation were computed to find the relationship between each of the variables and the grade-point averages of freshmen pre-veterinary medicine students enrolled at Colorado Agricultural and Mechanical College in 1946. The scores on all of the entrance examinations were available for 185 students. The scores on the entrance examinations and high-

school rank were available for 115 students. Five zero-order correlations were computed using the Pearson product-moment method (13:282-88).

2. Intercorrelations were calculated between each variable and every other variable to determine the extent to which the variables measured common factors and to assist in the selection of the variables upon which to base the regression equation. Ten intercorrelations were calculated using the Pearson product-moment method.

3. Using the obtained zero-order coefficients of correlation, multiple coefficients of correlation were computed to obtain the relationship between various combinations of the variables and grade-point averages. The method described by Garrett (13:414-424) was used to compute the 20 multiple coefficients of correlation.

4. The most efficient and practical combination of variables was used to calculate a regression equation for the purpose of predicting grade-point averages from the raw scores of the variables. The method described by Garrett (13:419-422) was used to calculate the regression equation.

5. An analysis of the scatter diagrams from which the zero-order coefficients of correlation were calculated was made to determine the predictive value of these variables for various levels of ability.

6. The standard error of estimate was calculated

to determine the accuracy with which the regression equation predicted the grade-point average.

7. Using the regression equation, predicted grade-point averages were calculated for each freshman student in pre-veterinary medicine at Colorado Agricultural and Mechanical College for the school year of 1945-46 and 1946-47. Zero-order coefficients of correlation were calculated to determine the relationship between predicted and achieved grades in each of the 1945-46 and 1946-47 groups.

#### Zero-order coefficients of correlation

The predictive value of the different variables was about the same for each variable as shown by the correlations with grade-point average, Table 8. The chemistry test was the best single predictor with a coefficient of correlation with grade-point average of .51. The A.C.E. and English tests were second with correlations of .50 with grade-point average. The Reading test with  $r = .48$  was fourth, and high-school rank with  $r = .46$  was the lowest single predictor of grade-point average.

The A.C.E., English, and Reading tests had the highest intercorrelations, Table 8. The correlation between the A.C.E. and Reading test was .71, between the A.C.E. and English tests .69, and between Reading and English tests .73. The intercorrelations between these three variables show that they measure common factors and

should add little toward the predictive efficiency of a combination of the variables when used together in a battery. High-school rank gave intercorrelations of .32 with the A.C.E., .31 with Reading, .36 with English, and .26 with the Chemistry test. The Chemistry test had a low correlation with other variables and, for that reason, should add to the predictive efficiency of a combination of the variables when included in a battery with them.

Table 8.--ZERO-ORDER COEFFICIENTS OF CORRELATION BETWEEN EACH VARIABLE AND EVERY OTHER VARIABLE.

Variables	(2)	(3)	(4)	(5)	(6)
N =	185	185	185	185	115
(1)	.50	.48	.50	.51	.46
(2)		.71	.69	.56	.32
(3)			.73	.62	.31
(4)				.54	.36
(5)					.26

(1) Grade-point average

(4) The English test

(2) The A.C.E.

(5) The Chemistry test

(3) The Reading test

(6) High-school rank

#### Multiple coefficients of correlation

Multiple coefficients of correlation were computed by the method described by Garrett (13:423-29). Various combinations of variables (the A.C.E. and the

Reading, English, and Chemistry tests, and high-school rank) were correlated with grade-point average to determine which combination would have the greatest predictive efficiency.

Of the multiple coefficients of correlation between grade-point average and a combination of two variables, Table 9, the highest multiple correlation, .61, was found between a combination of the Chemistry test and high-school rank. The multiple coefficients of correlation between a combination of two variables and grade-point average was found to be highest where high-school rank was included. The highest multiple coefficient of correlation not involving high-school rank was found to be .58 which was the correlation between a combination of the English and Chemistry tests with grade-point average.

Table 9.--MULTIPLE CORRELATION OF A COMBINATION OF TWO VARIABLES WITH GRADE-POINT AVERAGE

Combination of variables	(3)	(4)	(5)	(6)
R1.2x	.53	.54	.57	.59
R1.3x	x	.53	.55	.58
R1.4x	x	x	.58	.59
R1.5x	x	x	x	.61

For example, R1.23 may be found from the row R1.2x and the column 3. This value is .53.

- |                         |                        |
|-------------------------|------------------------|
| (1) Grade-point average | (4) The English test   |
| (2) The A.C.E.          | (5) The Chemistry test |
| (3) The Reading test    | (6) High-school rank   |

Multiple coefficients of correlation computed between various combinations of three variables and grade-point average showed that a combination of the English and Chemistry tests and high-school rank, and a combination of the A.C.E., Chemistry test and high-school rank gave multiple coefficients of correlation of .64 with grade-point average, Table 10. The multiple coefficient of correlation between a combination of the Reading and Chemistry tests and high-school rank, with grade-point average was found to be .63. All of the multiple coefficients of correlation between a combination of three variables and grade-point average were about the same. Again the multiple coefficients involving high-school rank were higher than those from which high-school rank was omitted.

Table 10.--MULTIPLE CORRELATIONS FOR A COMBINATION OF THREE VARIABLES WITH GRADE-POINT AVERAGE

Combination of variables	(4)	(5)	(6)
R1.23x	.55	.58	.60
R1.24x	x	.59	.60
R1.34x	x	.58	.60
R1.25x	x	x	.64
R1.35x	x	x	.63
R1.45x	x	x	.64

- |                         |                        |
|-------------------------|------------------------|
| (1) Grade-point average | (4) The English test   |
| (2) The A.C.E. test     | (5) The Chemistry test |
| (3) The Reading test    | (6) High-school rank   |

### The regression equation

The regression equation based on the data for the 1946-47 group of freshmen in pre-veterinary medicine was as follows:

$$W = .0056x_4 + .0084x_5 + 1.21$$

In the equation, the two independent variables  $x_4$  (raw score on the English test) and  $x_5$  (raw score on the Chemistry test) were used to predict the grade-point average of freshmen students in pre-veterinary medicine. 3/

### Analysis of the scatter diagrams

An analysis of the scatter diagrams from which the zero-order coefficients were obtained was made to determine how well the variables would predict the achievement of a grade-point average of at least 2.90, the approximate criterion of success in pre-veterinary medicine. This analysis failed to offer much in the way of prediction since many of those with low scores on the variables made high grade-point averages in pre-veterinary medicine. It was found, however, that the majority of those students

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3/ See Appendixes D and E for the achieved and predicted grade-point averages.

that had high scores on the variables achieved a correspondingly high grade-point average.

The standard error of estimate

The standard error of estimate for the predicted grade-point averages as calculated from the regression equation was .59 of a grade point. This standard error of estimate was calculated from the following formula:

$$\sigma_{(est)} = \sigma_1 \sqrt{1 - R^2_{1.23}}$$

- $\sigma_{(est)}$  = the standard error of estimate
- $\sigma_1$  = the standard deviation of achieved grade-point average distribution of the 1946-47 freshman pre-veterinary medicine group
- $R^2_{1.23}$  = the multiple coefficient of correlation between the English and Chemistry tests and achieved grade-point average of the 1946-47 freshman pre-veterinary medicine group.

Predictive efficiency of the regression equation

The coefficient of correlation between predicted grade-point averages that were calculated from the regression equation and achieved grade-point averages for the 1946-47 freshman pre-veterinary medicine group was .47. The coefficient of correlation between predicted grade-point averages calculated from the regression equation and achieved grade-point averages for the 1945-46 group of

pre-veterinary medicine students was .40.

The predicted grade-point averages calculated from the regression equation are the most probable grade-point averages that will be achieved with given scores on the English and Chemistry tests on which the regression equation was based. The standard error of estimate gives the probability that the true grade-point average will fall within the limits plus and minus .59 from the predicted grade-point average. This probability is 68 in 100 chances that the achieved grade-point averages will be not more than .59 of a grade point greater or smaller than the predicted grade-point averages calculated from the regression equation. It is almost certain that the actual grade-point average will fall within plus and minus three times the standard error of estimate from the predicted grade-point average (13:320-21).

## Chapter V

## DISCUSSION

The problem of this study, "How can the data available to advisors be used most effectively in the counseling program of Colorado Agricultural and Mechanical College for the guidance of freshmen planning to enter pre-veterinary medicine?", was studied under the following headings:

1. Relationship between scores achieved on the entrance examinations and grades achieved in pre-veterinary medicine.

2. Relationship between grades achieved in pre-veterinary medicine and high-school achievement expressed in terms of rank in the high-school graduating class.

3. Factors or combination of factors of optimum value in predicting grade-point average for freshmen in pre-veterinary medicine.

4. Weights assigned to retained criteria to obtain optimum prediction of grade-point average for freshmen pre-veterinary medicine students.

5. The way in which counselors may use the available data in the guidance of freshmen pre-veterinary medicine students.

Entrance examinations  
and pre-veterinary  
medicine grades

The entrance examinations, the A.C.E., the Chemistry test, the English test, and the Reading test, were studied to determine how well they predict grade-point average in pre-veterinary medicine at Colorado Agricultural and Mechanical College.

Predictive value of the A.C.E.--The correlation between the A.C.E. and grades in pre-veterinary medicine was found to be .50 in this study. This is in agreement with studies reported by Odell (27), 1927,  $r = .40$  to  $.50$ , and Durflinger (10), 1943,  $r = .52$  for tests of this type. The correlation found here is lower than that reported by Gould (15), 1944,  $r = .63$ , and by McClanahan (22), 1947,  $r = .648$  in studies made at Colorado Agricultural and Mechanical College.

Predictive value of the Reading test.--The Reading test was found to correlate .48 with grade-point average in pre-veterinary medicine. This closely agrees with the findings of Stinson (36), 1947,  $r = .464$ , and McClanahan (22), 1947,  $r = .495$ , for the same test at this college. McClanahan (22) found the Reading test to be the fourth best predictor of first-year grade-point average for freshmen engineering students; for freshmen pre-veterinary medicine students the test was also the fourth best predictor. Stinson (36) found that the Reading test

predicted grade-point average for non-high-school graduates better than did any of the other three entrance examinations.

Predictive value of the English test.--The English test correlated .50 with grades in pre-veterinary medicine. This was the same correlation as was found for the A.C.E. and only .01 lower than was found for the Chemistry test. Drake and Henmon (7) found a slightly higher correlation between the English test centiles and freshman grade-point average in 1937 at the University of Wisconsin,  $r = .54$ . Gould (15), 1944, and McClanahan (22), 1947, found correlations of .558 and .583 between the English test and the grade-point average of freshmen at Colorado Agricultural and Mechanical College.

The Predictive value of the Chemistry test.--The Chemistry test was found to be, by a small margin, the best predictor of grade-point average in pre-veterinary medicine,  $r = .51$ . This was about the same as the correlations of .50 found between the A.C.E. and English test with grade-point average. Gould (15), 1944, found the correlation for this same test to be .589 with first-semester grade-point average. Stinson (36), 1947, found a negative correlation of .027 between the Chemistry test and first-quarter grade-point average for non-high-school graduates. McClanahan found the Chemistry test to be the best predictor of freshman grade-point average in the Engineering School,

$r = .652$ . This study verifies the finding of Butsch (1), 1939, from which he concluded that the correlations vary so much in the different departments that it is necessary to make studies for each department of the college.

The predictive value of high-school rank.--Rank in the high-school graduating class was found to be the poorest predictor of grade-point average in pre-veterinary medicine,  $r = .46$ . Many studies have been made involving the use of high-school rank for predicting college scholarship in which both higher and lower correlations, than was found in this study, have been reported. Drake and Henmon (7), 1937, found a correlation of .60 between freshman grade-point average and high-school rank centiles, and Butsch (1), 1939, found correlations ranging from .471 to .559 in the various departments at Marquette University. The correlation of .46 found in this study is lower than that reported by Gould (15), 1944,  $r = .60$ , but it is higher than that found by McClanahan (22), 1947,  $r = .359$ . In this study and in the study made by McClanahan (22) high-school rank was the poorest predictor of grade-point average.

Intercorrelations between variables.--The intercorrelations between the variables were about the same except for high-school rank which had a lower intercorrelation with each of the other variables. The intercorrelations indicated that the A.C.E., English, and Reading tests

measured common factors as did the intercorrelations found by McClanahan (22), 1947, for the same variables. Since the Chemistry test was the best predictor of grades in pre-veterinary medicine, and, since the intercorrelation between the Chemistry test and English test was lower than that found between the Chemistry test and the other tests, a combination of the Chemistry and English tests was selected as the best battery of two tests for predicting grade-point average in pre-veterinary medicine.

#### Combinations of factors for prediction

Various combinations of the five variables, the A.C.E., Reading, English, and Chemistry tests, and high-school rank could not be expected to yield high multiple coefficients of correlation with grades in pre-veterinary medicine since each variable correlated quite low with grade-point average. Drake and Henmon (7), 1937, Gould (15), 1944, and McClanahan (22), 1947, found that combinations of variables beyond the number of three only slightly increased the obtained multiple coefficients of correlation. It was therefore decided that combinations of three variables would be the limits of the multiple coefficients computed. The multiple coefficients of correlation in this study ranged from .55 to .64 for the various combinations of three variables. The highest multiple coefficient, .64, for three variables

was obtained by using the English and Chemistry test and high-school rank. The highest multiple coefficient of correlation when high-school rank was omitted was .59.

The highest multiple coefficient of correlation of a combination of two variables with grade-point average in pre-veterinary medicine was .61 using the Chemistry test and high-school rank. The highest multiple coefficient of correlation of those using only the entrance examinations was obtained using the English and Chemistry tests,  $r = .58$ . This was much lower than that found by McClanahan (22), 1947,  $r = .814$  for the same two variables in his study of engineering freshmen at Colorado Agricultural and Mechanical College.

The multiple coefficients of correlation found in this study are not as high as desirable for predictive purposes; however, Quaid (30), 1938, obtained multiple coefficients with grade-point average that ranged from .59 to .62. Butsch (1), 1939, found multiple coefficients of correlation with grade-point average that varied from .58 to .65 for various departments at Marquette University.

#### Weights assigned to secure optimum prediction

Although combinations involving the use of high-school rank produced higher multiple coefficients than did other combinations, it was decided that high-school rank would not be used. High-school rank is not recorded for

many students at Colorado Agricultural and Mechanical College, and the various ways in which rank in the high-school graduating class is recorded give reason to doubt the validity of scores obtained for predictive purposes. The combination of the Chemistry test and English test with a multiple  $R = .58$  was only .06 lower than the highest multiple  $R$  for three variables, and .03 lower than the combination of the Chemistry test and high-school rank. It was decided that the combination of the English and Chemistry tests was the best and most practical combination to use in the regression equation.

The following regression equation was computed to obtain the weights to be assigned to the English and Chemistry scores for predicting the grade-point average of freshmen pre-veterinary medicine students:

$$W = .0056x_4 + .0084x_5 + 1.21$$

In the equation,  $x_4$  is the raw score on the English test and  $x_5$  is the raw score on the Chemistry test.

#### The use of the data by counselors

The regression equation predicted the "most probable" grade-point average for a student when his raw scores on the English and Chemistry tests were known. The standard error of the predicted score was found to be .59 of a grade point. McClanahan (22), 1947, found the standard error of estimate to be .45 of a grade point.

The results of this study indicate that the data available to counselors, the scores achieved on the entrance examinations and high-school rank, do not offer a reliable means of predicting success for freshmen students that plan to enter the course in pre-veterinary medicine at Colorado Agricultural and Mechanical College. This study indicated that counselors may give some assurance of a fair degree of scholastic achievement to those that achieve a high score on the entrance examinations and have a high-school rank that is in the upper 75 per cent. The study failed to show a significantly high relationship between low scores on the variables and poor achievement in pre-veterinary medicine. Some students that achieved very low scores on the entrance examinations achieved a high grade-point average. The majority of those that achieved high scores on the entrance examinations achieved a correspondingly high grade-point average in pre-veterinary medicine. The results of this study agree with the statement made by Leaf (20), 1940, when he concluded:

The studies have shown definitely that it is impossible to foretell the scholastic achievement of all the students in a given group, and that many cases of success or failure cannot be discovered until the student has tried to do college work. (20:303)

#### Recommendations for further study

The regression equation developed on the scores obtained by the 1946-47 freshmen in pre-veterinary medicine

was not as predictive as was expected. Another study, made at a later date, after the disturbing influences of World War II have diminished, may offer a better basis for prediction in pre-veterinary medicine.

There are other factors that influence the selection of those that are admitted into the veterinary school other than scholastic achievement in pre-veterinary medicine. A battery of tests including a good personality inventory, an interest inventory, and a study habits inventory should provide the basis for another study from which counselors of pre-veterinary medicine students may benefit.

A study to determine the relationship between success in pre-veterinary medicine and success in the veterinary school would be of great benefit to counselors.

## Chapter VI

## SUMMARY

This study was selected and carried out for the purpose of determining what relationships exist between success in pre-veterinary medicine and the data that are available to counselors in the guidance program of freshmen planning to enter pre-veterinary medicine at Colorado Agricultural and Mechanical College. Counselors need to know what these relationships are if they are to make use of the data that are available to them for counseling and guidance purposes.

The following data were collected on freshmen pre-veterinary medicine students of 1946-47:

1. Achieved grade-point average.  
N = 185 (variable 1)
2. Raw score on the American Council on Education Psychological Examination.  
N = 185 (variable 2)
3. Raw score on the Nelson-Denny Reading test.  
N = 185 (variable 3)
4. Raw score on the Cooperative English test.  
N = 185 (variable 4)

5. Raw score on the Iowa Chemistry test.

N = 185 (variable 5)

6. Rank in high-school graduating class.

N = 115 (variable 6)

The zero-order coefficients of correlation calculated between each of the variables and grade-point average (variable 1) were found to be as follows:

- |                   |                   |
|-------------------|-------------------|
| 1. $r_{12} = .50$ | 2. $r_{13} = .48$ |
| 3. $r_{14} = .50$ | 4. $r_{15} = .51$ |
| 5. $r_{16} = .46$ |                   |

The highest multiple coefficients of correlation for combinations of three variables with grade-point average were as follows:

- |                     |                     |
|---------------------|---------------------|
| 1. $R_1(245) = .59$ | 2. $R_1(256) = .64$ |
| 3. $R_1(365) = .63$ | 4. $R_1(456) = .64$ |

The highest multiple coefficients of correlations for combinations of two variables with grade-point average were as follows:

- |                    |                    |
|--------------------|--------------------|
| 1. $R_1(25) = .57$ | 2. $R_1(26) = .59$ |
| 3. $R_1(36) = .58$ | 4. $R_1(46) = .59$ |
| 5. $R_1(45) = .58$ | 6. $R_1(56) = .61$ |

The combination of the two variables, the English and Chemistry tests, was selected as the best and most economical battery to use in the calculation of the predicted grade-point averages. The following regression equation was developed:

$$W = .0056x_4 + .0084x_5 + 1.21$$

Where W = Predicted grade-point average

$x_4$  = English raw score, and

$x_5$  = Chemistry raw score.

The standard error of estimate for the predicted grade-point averages was found to be .59. The correlation between the predicted grade-point average and achieved grade-point average for the 1946-47 freshmen pre-veterinary medicine students was found to be .47. For the purpose of checking the results obtained from the regression equation the correlation between the predicted and achieved grade-point for the 1945-46 freshmen pre-veterinary medicine students was computed and found to be .40.

#### Summary and implications

The best single predictor of grade-point average for freshmen students of pre-veterinary medicine was the Chemistry test, and high-school rank was the poorest. Intercorrelations among the variables indicated that the A.C.E., Reading, and the English tests measured common factors and that the combination of the English and Chemistry tests was the best combination of two tests for predictive purposes. The addition of other variables did not increase the predictive value of the English and Chemistry combination enough to justify using more than two variables.

Grade-point averages predicted from the regression

equation did not predict actual grade-point averages well enough to be of much value to counselors. Freshmen students of pre-veterinary medicine that achieved high scores on the variables may be given some assurance that they will achieve a correspondingly high grade-point average.

However, students that did not achieve high scores on the variables did not achieve a correspondingly low grade-point average so that a critical score could be determined below which the student would have a slight possibility of achieving a grade-point average of 3.00, the criterion of success in pre-veterinary medicine.

**A P P E N D I X**

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Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
1	PVM	Dropped			x
2	PVM	PVM	PVM		x
3	PVM	PVM	PVM		x
4	PVM	PVM	PVM	x	
5	PVM	PVM	Ag		x
6	PVM	PVM	Dropped	x	
7	PVM	PVM	Ag	x	
8	PVM	PVM	PVM	x	
9	PVM	PVM	PVM	x	
10		PVM	PVM		x
11	PVM	PVM	PVM		x
12	PVM	Gen.Sci.			x
13	PVM	PVM	PVM	x	
14		PVM	PVM		x
15	PVM	PVM	Dropped		x
16		PVM	PVM		x
17	PVM	PVM	PVM	x	
18		PVM	PVM		x
19	PVM	PVM	PVM		x
20		PVM	PVM		x
21		PVM	Dropped		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
22		PVM	PVM		x
23	PVM	PVM	PVM	x	
24		PVM	PVM		x
25	PVM	Gen. Sci.		x	
26	PVM	PVM	PVM	x	
27	PVM	Dropped			x
28	PVM	Dropped			x
29	PVM	PVM	PVM	x	
30	PVM	PVM	PVM	x	
31	PVM	PVM	PVM	x	
32	PVM	PVM	PVM	x	
33	PVM	PVM	PVM	x	
34	PVM	PVM	PVM	x	
35	PVM	PVM	PVM	x	
36	PVM	Dropped			x
37		PVM	PVM		x
38		PVM	PVM		x
39	PVM	Dropped		x	
40	PVM	PVM	PVM	x	
41	PVM	PVM	PVM	x	
42	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
43	PVM	PVM	Dropped	x	
44	PVM	PVM	PVM		x
45	PVM	PVM	PVM		x
46	PVM	Dropped		x	
47	PVM	PVM	PVM		x
48	PVM	PVM	PVM		x
49	PVM	PVM	PVM	x	
50	PVM	PVM	PVM	x	
51		PVM	Dropped		x
52	PVM	PVM	PVM		x
53		PVM	PVM		x
54	PVM	PVM	PVM	x	
55	PVM	Dropped			x
56	PVM	PVM	PVM	x	
57	PVM	PVM	PVM	x	
58	PVM	PVM	PVM	x	
59	PVM	PVM	PVM	x	
60	PVM	PVM	PVM		x
61	PVM	PVM	PVM		x
62	PVM	PVM	PVM	x	
63		PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
64	PVM	PVM	PVM	x	
65	PVM	PVM	PVM		x
66	PVM	PVM	PVM		x
67	PVM	Ag.			x
68	PVM	PVM	PVM	x	
69	PVM	Dropped			x
70	PVM	PVM	PVM		x
71		PVM	PVM		x
72	PVM	PVM	PVM	x	
73	PVM	PVM	Dropped	x	
74	PVM	PVM	PVM	x	
75	PVM	PVM	PVM		x
76	PVM	PVM	PVM		x
77	PVM	A. H.			x
78	PVM	PVM	PVM	x	
79	PVM	Dropped			x
80		PVM	PVM		x
81	PVM	PVM	PVM	x	
82	PVM	PVM	PVM		x
83	PVM	PVM	Dropped		x
84	PVM	Ag.			x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
85	PVM	PVM	PVM	x	
86	PVM	PVM	PVM	x	
87	PVM	PVM	PVM		x
88	PVM	Dropped		x	
89	PVM	PVM	PVM	x	
90	PVM	Dropped			x
91	PVM	PVM	PVM		x
92	PVM	PVM	PVM		x
93	PVM	PVM	PVM	x	
94	PVM	PVM	PVM		x
95	PVM	PVM	P. E.	x	
96	PVM	PVM	PVM		x
97	PVM	PVM	PVM	x	
98	PVM	PVM	Dropped		x
99	PVM	PVM	Dropped		x
100	PVM	PVM	Dropped	x	
101	PVM	PVM	Dropped		x
102	PVM	PVM	PVM		x
103	PVM	PVM	PVM		x
104	PVM	PVM	Dropped		x
105	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
106		PVM	PVM		x
107	PVM	PVM	PVM		x
108		PVM	PVM		x
109	PVM	Dropped		x	
110	PVM	PVM	PVM	x	
111			PVM		x
112	PVM	Ag.		x	
113	PVM	PVM	Dropped	x	
114	PVM	PVM	PVM	x	
115		PVM	PVM		x
116	PVM	Dropped		x	
117	PVM	PVM	PVM	x	
118	PVM	PVM	PVM	x	
119	PVM	PVM	PVM	x	
120	PVM	PVM	PVM	x	
121	PVM	PVM	PVM	x	
122		PVM	Dropped		x
123	PVM	PVM	PVM		x
124	PVM	Dropped			x
125	PVM	PVM	PVM		x
126		PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
127	PVM	PVM	PVM	x	
128		PVM	PVM		x
129	PVM	PVM	PVM		x
130	PVM	PVM	PVM	x	
131		PVM	PVM		x
132	PVM	PVM	PVM	x	
133	PVM	PVM	PVM		x
134		PVM	PVM		x
135	PVM	PVM	PVM	x	
136	PVM	PVM	PVM	x	
137	PVM	PVM	PVM		x
138	PVM	PVM	Dropped	x	
139	PVM	PVM	PVM		x
140	PVM	PVM	PVM	x	
141	PVM	PVM	PVM		x
142	PVM	PVM	PVM	x	
143	PVM	PVM	Dropped		x
144	PVM	PVM	Ag.	x	
145	PVM	PVM	PVM	x	
146		PVM	PVM		x
147	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
148		PVM	PVM		x
149	PVM	PVM	Dropped	x	
150	PVM	PVM	PVM	x	
151	PVM	PVM	Ag.	x	
152	PVM	PVM	PVM	x	
153	PVM	PVM	PVM	x	
154	PVM	PVM	Gen. Sci.		x
155	PVM	Gen. Sci.		x	
156	PVM	PVM	PVM	x	
157		PVM	PVM		x
158	PVM	PVM	PVM	x	
159		PVM	PVM		x
160	PVM	PVM	Soc.	x	
161		PVM	PVM		x
162		PVM	PVM		x
163		PVM	Dropped		x
164	PVM	PVM	Dropped	x	
165	PVM	PVM	PVM		x
166	PVM	PVM	PVM	x	
167	PVM	PVM	PVM		x
168	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
169	PVM	PVM	PVM	x	
170	PVM	Ag.		x	
171	PVM	C.			x
172	PVM	PVM	Ag.	x	
173	PVM	PVM	PVM	x	
174	PVM	PVM	PVM	x	
175	PVM	PVM	PVM		x
176	Eng.	PVM	PVM		x
177	PVM	PVM	PVM		x
178	PVM	PVM	PVM	x	
179	PVM	Dropped			x
180	PVM	PVM	Ag.	x	
181	PVM	Dropped			x
182		PVM	PVM		x
183		PVM	PVM		x
184	PVM	PVM	PVM	x	
185	PVM	PVM	PVM	x	
186	PVM	PVM	PVM	x	
187	PVM	PVM	Dropped		x
188	PVM	Dropped			x
189	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
190	PVM	Dropped		x	
191	PVM	PVM	PVM	x	
192	PVM	Ag.		x	
193	PVM	PVM	PVM	x	
194	PVM	PVM	Ag.		x
195	PVM	PVM	PVM		x
196	PVM	PVM	PVM	x	
197		PVM	Zool.		x
198	PVM	PVM	PVM	x	
199	PVM	PVM	PVM	x	
200	PVM	Dropped			x
201	PVM	Dropped		x	
202	PVM	PVM	PVM		x
203	PVM	PVM	Ag.	x	
204	PVM	PVM	PVM	x	
205	PVM	Dropped			x
206	PVM	PVM	PVM		x
207	PVM	PVM	PVM	x	
208	PVM	Ag.		x	
209	PVM	PVM	PVM		x
210	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
211	Ag.	PVM	PVM		x
212	A & S	PVM	PVM		x
213	PVM	PVM	PVM	x	
214	PVM	PVM	PVM		x
215	PVM	PVM	PVM	x	
216	PVM	PVM	PVM		x
217	PVM	Dropped		x	
218	PVM	PVM	PVM	x	
219	PVM	PVM	Gen. Sci.		x
220	PVM	PVM	PVM	x	
221	PVM	PVM	PVM	x	
222	PVM	PVM	Ec.	x	
223	PVM	Dropped			x
224	PVM	PVM	PVM	x	
225	PVM	PVM	Gen. Sci.	x	
226	PVM	PVM	PVM	x	
227	PVM	Gen. Sci.			x
228	PVM	PVM	PVM	x	
229	PVM	PVM	PVM		x
230	PVM	PVM	PVM		x
231	PVM	AH	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
232	PVM	PVM	PVM	x	
233	PVM	PVM	Dropped	x	
234		PVM	PVM		x
235		Grad.	PVM		x
236	PVM	PVM	Dropped	x	
237	PVM	PVM	PVM	x	
238	PVM	Dropped			x
239	PVM	PVM	PVM		x
240	PVM	PVM	PVM	x	
241	PVM	PVM	PVM		x
242	PVM	PVM	PVM	x	
243	PVM	PVM	PVM	x	
244	PVM	PVM	PVM		x
245	PVM	PVM	PVM	x	
246	PVM	PVM	PVM	x	
247	PVM	PVM	PVM	x	
248	A & S	Gen. Sci.	PVM		x
249	PVM	PVM	Dropped		x
250	PVM	PVM	PVM		x
251	PVM	PVM	Dropped	x	
252	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
253	PVM	PVM	PVM		x
254	PVM	PVM	PVM	x	
255	PVM	PVM	PVM	x	
256	PVM	PVM	PVM	x	
257	PVM	PVM	Dropped		x
258	PVM	PVM	Dropped		x
259	PVM	PVM	PVM	x	
260		PVM	PVM		x
261		PVM	PVM		x
262		PVM	PVM		x
263	PVM	PVM	PVM	x	
264	PVM	Gen. Sci.			x
265		PVM	P. E.		x
266		PVM	PVM		x
267	PVM	PVM	PVM	x	
268	PVM	PVM	PVM	x	
269	PVM	PVM	Ag.	x	
270	PVM	PVM	PVM		x
271	PVM	PVM	PVM	x	
272	PVM	PVM	PVM		x
273	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
274	PVM	PVM	PVM		x
275		PVM	PVM		x
276	PVM	PVM	PVM	x	
277	PVM	PVM	PVM	x	
278	PVM	PVM	Dropped		x
279		PVM	PVM		x
280	PVM	PVM	Ag.	x	
281	PVM	PVM	PVM		x
282	PVM	PVM	PVM	x	
283	PVM	PVM	Gen. Sci.	x	
284	PVM	Dropped			x
285	PVM	PVM	PVM	x	
286	PVM	PVM	PVM		x
287	PVM	PVM	PVM		x
288	PVM	PVM	PVM	x	
289	PVM	PVM	PVM		x
290	PVM	PVM	PVM	x	
291	PVM	PVM	PVM	x	
292	PVM	PVM	PVM		x
293	PVM	Dropped			x
294	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
295		PVM	PVM		x
296	PVM	PVM	PVM		x
297	PVM	Dropped		x	
298	PVM	PVM	PVM	x	
299	PVM	PVM	PVM		x
300	PVM	PVM	PVM		x
301		PVM	Dropped		x
302	PVM	PVM	PVM		x
303	PVM	PVM	Gen. Sci.		x
304	PVM	Dropped		x	
305	PVM	PVM	PVM	x	
306		PVM	PVM		x
307	PVM	Dropped			x
308	PVM	PVM	PVM	x	
309	PVM	Dropped			x
310			PVM		x
311	PVM	Dropped			x
312	PVM	PVM	PVM		x
313		PVM	PVM		x
314	PVM	Eng.			x
315		PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
316	PVM	PVM	PVM	x	
317		PVM	PVM		x
318	PVM	PVM	Ag.	x	
319	PVM	PVM	Dropped	x	
320	PVM	PVM	PVM		x
321	PVM	PVM	PVM		x
322	PVM	PVM	PVM		x
323	PVM	PVM	PVM		x
324	PVM	PVM	Gen. Sci.	x	
325	PVM	PVM	PVM		x
326	PVM	PVM	PVM	x	
327	PVM	PVM	Dropped	x	
328	PVM	PVM	PVM	x	
329		PVM	PVM		x
330	PVM	PVM	PVM	x	
331		PVM	PVM		x
332		PVM	PVM		x
333	PVM	PVM	PVM	x	
334	PVM	PVM	PVM		x
335	PVM	Dropped		x	
336	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
337	PVM	Dropped		x	
338	PVM	PVM	PVM		x
339	PVM	Dropped		x	
340	PVM	PVM	PVM	x	
341		PVM	PVM		x
342	PVM	PVM	PVM	x	
343	PVM	PVM	PVM		x
344	PVM	PVM	PVM		x
345		PVM	Dropped		x
346	PVM	PVM	PVM		x
347	PVM	PVM	Dropped	x	
348	PVM	Gen. Sci.		x	
349	PVM	PVM	PVM	x	
350	PVM	PVM	PVM		x
351	PVM	Dropped		x	
352	PVM	PVM	PVM		x
353	PVM	PVM	PVM		x
354	PVM	PVM	PVM		x
355	PVM	PVM	PVM	x	
356	PVM	PVM	PVM		x
357	PVM	PVM	PVM	x	

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
358	PVM	Dropped		x	
359	PVM	PVM	PVM		x
360	PVM	Ag.		x	
361	PVM	PVM	PVM	x	
362	PVM	PVM	Ag.	x	
363	PVM	PVM	PVM		x
364	PVM	PVM	PVM		x
365	PVM	PVM	PVM		x
366	PVM	PVM	PVM	x	
367	PVM	PVM	PVM	x	
368	PVM	PVM	PVM		x
369	PVM	PVM	PVM		x
370	PVM	PVM	Dropped	x	
371	PVM	Dropped			x
372		PVM	PVM		x
373	PVM	Dropped			x
374	PVM	PVM	PVM	x	
375	PVM	Dropped			x
376		PVM	PVM		x
377	PVM	Dropped			x
378	PVM	PVM	PVM		x

Appendix A.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE FOR THE  
 THREE QUARTERS OF 1946-47.--Continued

Case Number	Fall quarter	Winter quarter	Spring quarter	Freshmen studied	Students not included in study
379	PVM	PVM	PVM	x	
380	PVM	PVM	PVM	x	
381	PVM	PVM	PVM		x
382	PVM	PVM	PVM		x
383	PVM	PVM	Dropped	x	
384	PVM	PVM	Dropped	x	
385		PVM	PVM		x
386	PVM	PVM	PVM	x	
387		PVM	Ag.		x
388	PVM	PVM	PVM	x	
389	PVM	Gen. Sci.			x
390	PVM	PVM	PVM	x	
391	PVM	PVM	PVM	x	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS

Case Number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
4	1.21	95	96	42	41	38
6	2.64	87	79	14	53	
7	1.45	107	115	50	48	50
8	1.02	53	56	6	29	88
9	3.54	106	139	48	88	63
13	3.04	119	176	16	92	
17	1.62	113	141	88	52	
23	1.97	114	119	14	87	38
25	1.27	114	98	47	80	
26	3.74	132	167	50	83	
29	2.42	42	62	21	35	
30	3.52	165	202	87	115	
31	3.49	114	177	85	91	
32	2.94	124	125	49	88	63
33	2.78	135	154	114	88	46
34	2.87	127	200	78	106	
35	2.54	95	158	25	76	70
39	2.00	95	150	15	77	81
40	3.40	96	139	43	62	68
41	2.22	144	98	52	69	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
43	2.25	122	112	15	80	63
46	.75	82	79	6	44	
49	3.65	132	185	82	100	63
50	1.58	99	124	67	65	66
54	1.89	42	96	9	56	38
56	1.73	106	144	36	78	63
57	1.94	119	179	88	73	63
58	2.64	117	115	38	65	38
59	2.22	99	106	20	62	
62	2.57	102	101	51	69	38
64	1.49	87	96	14	55	
68	2.36	108	141	15	65	
72	3.05	95	120	11	70	
73	1.87	87	133	12	63	
74	3.07	97	113	14	73	44
78	3.00	134	194	55	91	95
81	2.64	87	68	14	56	19
85	3.18	101	120	15	65	
86	2.16	87	101	6	47	63
88	2.00	104	124	14	78	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
89	1.93	144	173	42	86	29
93	2.65	132	192	51	64	50
95	.19	58	93	12	35	
97	2.94	106	101	29	48	51
100	2.40	113	124	56	40	27
105	2.98	99	127	16	57	63
109	1.69	89	112	11	62	
110	3.83	151	207	105	115	88
112	2.13	76	170	6	98	13
113	2.00	121	192	11	77	
114	2.22	120	203	102	128	38
116	1.47	106	123	11	74	14
117	2.89	89	104	23	50	83
118	2.14	90	119	41	72	
119	1.96	136	159	62	93	53
120	2.82	122	192	52	109	
121	3.43	94	106	105	64	
127	3.89	135	203	100	94	
130	2.77	114	120	67	88	88
132	2.00	112	115	21	73	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
135	1.70	119	148	50	82	21
136	3.22	122	136	51	86	88
138	1.23	81	87	17	49	22
140	2.91	95	119	32	49	
142	3.22	142	218	24	138	88
144	2.83	127	198	15	100	
145	1.83	77	141	16	78	
147	3.75	111	200	105	77	88
149	1.53	92	119	29	59	63
150	1.98	99	153	35	73	
151	3.32	111	137	79	78	82
152	1.89	129	148	56	86	13
153	2.93	135	235	52	113	
155	2.69	136	141	25	117	48
156	1.25	101	101	9	58	
158	3.42	119	173	15	109	57
160	2.54	112	144	64	78	88
164	2.94	104	120	35	76	
166	1.57	74	147	15	55	14
168	2.15	77	96	25	54	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
169	2.19	129	132	50	85	38
170	1.73	102	106	51	86	23
172	2.21	85	139	6	67	35
173	2.78	102	129	14	77	38
174	2.37	144	205	49	100	
178	3.09	121	169	91	92	
180	1.19	93	134	22	73	13
184	1.98	89	123	47	83	
185	1.31	82	119	6	70	
186	2.53	102	187	20	76	
190	1.74	96	170	16	93	88
191	1.48	87	106	17	60	
192	1.11	79	113	14	54	
193	3.00	117	176	46	70	63
196	2.96	113	115	38	77	
198	2.18	99	106	6	70	13
199	2.22	129	150	52	103	36
201	1.67	100	167	12	90	43
203	2.37	121	187	22	91	63
204	2.34	85	93	31	57	10

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
207	1.86	104	117	16	69	
208	1.33	53	68	6	38	30
213	2.10	104	137	14	78	61
215	2.37	107	134	20	77	13
217	2.23	123	183	59	115	49
218	1.23	99	90	15	58	11
220	1.76	119	145	9	63	94
221	2.55	108	180	35	68	
222	2.11	117	153	14	109	
224	3.41	176	246	114	148	
225	2.18	96	115	11	87	63
226	2.43	108	112	6	77	13
228	3.40	58	177	64	77	73
232	1.59	95	96	43	67	
233	2.25	117	124	25	65	
236	2.85	115	90	15	86	
237	2.80	102	158	49	64	65
240	2.81	144	211	79	109	38
242	3.00	90	127	65	77	
243	1.76	107	120	11	60	

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
245	2.06	134	242	56	128	88
246	3.07	112	155	71	65	
247	2.44	95	145	12	64	38
251	2.20	89	128	14	56	48
252	3.42	138	198	56	109	52
254	2.32	106	127	27	72	72
255	3.20	124	155	87	89	87
256	2.42	108	155	59	69	
259	2.51	86	128	20	60	88
263	3.39	130	202	77	94	
267	2.58	119	123	21	57	48
268	2.77	136	172	66	98	30
269	1.26	94	96	14	47	
271	2.60	176	231	76	95	63
276	1.81	99	140	35	59	58
277	2.89	97	134	88	87	63
280	2.45	119	98	14	69	
282	2.47	112	187	55	92	74
283	2.27	132	209	56	77	63
285	2.35	90	107	14	57	82

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
288	2.67	58	68	14	40	
290	1.34	58	132	14	58	
291	2.29	112	154	28	86	63
297	.62	86	115	9	54	38
298	3.70	142	218	56	98	94
304	3.13	127	154	82	122	
305	3.13	176	200	85	85	
308	2.06	115	153	36	70	63
316	3.38	108	162	21	89	75
318	.96	42	62	6	40	13
319	1.69	106	152	15	77	38
324	1.75	69	113	14	52	17
326	2.22	96	125	41	97	55
327	1.23	58	158	6	54	13
328	2.82	132	173	35	93	83
330	2.53	95	200	12	60	13
333	1.89	61	72	6	41	
335	2.00	58	75	14	29	
336	2.78	126	207	42	109	90
337	3.00	127	158	85	92	63

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
339	2.56	102	151	52	70	63
340	2.40	92	96	52	84	60
342	2.44	138	231	50	128	88
347	.59	58	84	6	47	
348	1.86	82	123	50	58	18
349	2.00	80	132	6	59	
351	2.80	121	160	35	87	
355	1.60	113	146	64	63	63
357	1.39	132	152	67	85	
358	2.38	119	167	24	80	
360	.17	66	79	6	47	13
361	2.02	114	149	12	82	25
362	2.39	104	113	50	64	63
366	1.90	134	153	52	40	12
367	3.26	142	246	95	122	
370	1.50	119	132	12	78	
374	2.67	121	205	88	95	31
379	2.61	124	170	66	86	38
380	2.86	107	200	105	60	
383	2.70	142	167	73	86	88

Appendix B.--VARIATES USED IN THE STUDY OF THE 1946-47  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS.--Continued

Case number	Grade-point average achieved in pre-veterinary medicine	A.C.E. raw score	English raw score	Chemistry raw score	Reading raw score	High school rank
384	2.57	102	150	71	50	
386	2.34	119	101	77	69	13
388	1.85	126	164	15	74	88
390	3.02	127	176	55	84	
391	2.26	104	145	82	89	38

Appendix C.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE 1945-46.

Case number	Freshmen studied	Advanced students or students for whom no data was available	Admitted into veterinary school in 1946
1	x		x
2	x		
3	x		
4	x		
5	x		x
6	x		
7	x		
8	x		x
9	x		
10	x		
11		x	
12	x		
13	x		
14	x		
15	x		
16	x		
17	x		
18		x	
19	x		
20	x		
21	x		

Appendix C.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE  
 1945-46.--Continued

Case number	Freshmen studied	Advanced students or students for whom no data was available	Admitted into veterinary school in 1946
22		x	x
23	x		
24	x		x
25	x		
26	x		x
27		x	x
28	x		
29	x		
30	x		
31		x	
32	x		x
33	x		
34	x		
35	x		
36		x	
37		x	
38		x	x
39	x		
40	x		
41	x		

Appendix C.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
 COLORADO AGRICULTURAL AND MECHANICAL COLLEGE  
 1945-46.--Continued

Case number	Freshmen studied	Advanced students or students for whom no data was available	Admitted into veterinary school in 1946
42	x		
43	x		
44	x		
45	x		
46		x	
47	x		
48	x		
49	x		
50		x	
51		x	
52		x	x
53	x		
54	x		
55	x		
56		x	
57		x	
58		x	
59	x		
60	x		
61	x		

Appendix C.--ENROLLMENT IN PRE-VETERINARY MEDICINE AT  
COLORADO AGRICULTURAL AND MECHANICAL COLLEGE  
1945-46.--Continued

Case number	Freshmen studied	Advanced students or students for whom no data was available.	Admitted into veterinary school in 1946
62		x	
63	x		
64		x	
65		x	
66		x	
67	x		
68	x		
69		x	
70	x		x
71		x	x

Appendix D.--VARIATES USED IN THE STUDY OF THE 1945-46  
FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
AND PREDICTED GRADE-POINT AVERAGES.

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
1	2.88	133	76	2.59
2	2.60	97	40	2.08
3	1.61	121	15	2.01
4	2.70	131	55	2.40
5	2.72	131	55	2.40
6	1.82	127	72	2.52
7	1.79	100	7	1.83
8	3.35	159	39	2.43
9	2.41	150	69	2.63
10	1.93	199	43	2.69
12	2.66	175	69	2.77
13	3.09	211	40	2.73
14	2.35	185	108	3.15
15	1.81	64	8	1.64
16	1.59	135	31	2.23
17	2.62	159	59	2.60
19	1.51	137	75	2.61
20	2.55	235	39	2.85
21	2.07	189	35	2.56
23	3.39	163	42	2.48
24	1.75	84	81	2.36

Appendix D.--VARIATES USED IN THE STUDY OF THE 1945-46  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
25	2.04	200	55	2.79
26	3.27	210	20	2.55
28	2.54	197	90	3.07
29	1.73	245	29	2.82
30	1.15	83	29	1.89
32	3.68	233	76	3.15
33	3.40	158	96	2.90
34	1.66	130	41	2.28
35	2.60	176	20	2.35
39	2.39	121	30	2.14
40	1.78	192	14	2.40
41	2.04	97	7	1.81
42	.61	143	55	2.47
43	2.60	192	87	3.01
44	2.09	201	73	2.95
45	1.51	194	71	2.89
47	1.97	185	34	2.52
48	1.75	162	44	2.49
49	3.07	172	88	2.91
53	2.01	233	59	3.01
54	2.11	175	43	2.55

Appendix D.--VARIATES USED IN THE STUDY OF THE 1945-46  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
55	2.91	121	49	2.30
59	2.42	136	23	2.16
60	1.82	155	17	2.22
61	1.69	139	82	2.68
63	1.92	174	66	2.74
67	1.89	53	31	1.77
68	2.93	146	57	2.51
70	3.15	244	100	3.42

Appendix E.--VARIATES OF THE SAMPLE OF THE 1946-47  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
4	1.21	96	42	2.10
7	1.45	115	48	2.26
9	3.54	139	48	3.19
17	1.62	141	88	2.74
25	1.27	98	47	2.15
29	2.42	62	21	1.73
31	3.49	177	85	2.92
33	2.78	154	114	3.03
35	2.54	158	25	2.30
40	3.40	139	43	2.35
43	2.25	112	15	1.96
49	3.65	185	82	2.93
54	1.89	96	9	1.82
57	1.94	179	88	2.95
59	2.22	106	20	1.97
64	1.49	96	14	1.87
72	3.05	120	11	1.97
74	3.07	113	14	1.96
81	2.64	68	14	1.71
86	2.16	101	6	1.83
89	1.93	173	42	1.53

Appendix E.--VARIATES OF THE SAMPLE OF THE 1946-47  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
95	.19	93	12	1.81
100	2.40	124	56	2.37
109	1.69	112	11	1.93
112	2.13	170	6	2.21
114	2.22	203	102	3.20
117	2.89	104	23	1.99
119	1.96	159	62	2.62
121	3.43	106	105	2.69
130	2.77	120	67	2.44
135	1.70	148	50	2.46
138	1.23	87	17	1.84
142	3.22	218	24	2.63
145	1.83	141	16	2.13
149	1.53	119	29	2.12
151	3.32	137	79	2.64
153	2.93	235	52	2.96
156	1.25	101	9	1.85
160	2.54	144	64	2.55
166	1.57	147	15	2.16
169	2.19	132	50	2.37
172	2.21	139	6	2.04

Appendix B.--VARIATES OF THE SAMPLE OF THE 1946-47  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
174	2.37	205	49	2.77
180	1.19	134	22	2.15
185	1.31	119	6	1.93
190	1.74	170	16	2.30
192	1.11	113	14	1.86
196	2.96	115	38	2.17
199	2.22	150	52	2.49
203	2.37	187	22	2.44
207	1.86	117	16	2.00
213	2.10	137	14	2.10
217	2.23	183	59	2.73
220	1.76	145	9	2.10
222	2.11	153	14	1.97
225	2.18	115	11	1.94
228	3.40	177	64	2.74
233	2.25	124	25	2.11
237	2.80	158	49	2.51
242	3.00	127	65	2.47
245	2.06	242	56	3.04
247	2.44	145	12	2.12
252	3.42	198	56	2.79

Appendix E.--VARIATES OF THE SAMPLE OF THE 1946-47  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
255	3.20	155	87	2.87
259	2.51	128	20	2.09
267	2.58	123	21	2.08
269	1.26	96	14	1.88
276	1.81	140	35	2.28
280	2.45	98	14	1.88
283	2.27	209	56	2.85
288	2.67	68	14	1.71
291	2.29	154	28	2.31
298	3.70	218	56	2.90
305	3.13	200	85	3.04
316	3.38	162	21	2.29
319	1.69	152	15	2.19
326	2.22	125	41	2.25
328	2.82	173	35	2.47
333	1.89	72	6	1.66
336	2.78	207	42	2.72
339	2.56	151	52	2.49
342	2.44	231	50	2.92
348	1.86	123	50	2.32
351	2.80	160	35	2.41

Appendix E.--VARIATES OF THE SAMPLE OF THE 1946-47  
 FRESHMEN PRE-VETERINARY MEDICINE STUDENTS WITH ACHIEVED  
 AND PREDICTED GRADE-POINT AVERAGES.--Continued

Case number	Achieved grade-point average	English raw score	Chemistry raw score	Predicted grade-point average
357	1.39	152	67	2.63
360	.17	79	6	1.70
362	2.39	113	50	2.26
367	3.26	246	95	3.38
374	2.67	205	88	3.10
380	2.86	200	105	3.18
384	2.57	150	71	2.64
388	1.85	164	15	2.25
391	2.26	145	82	2.71

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