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A Statistical Study of the Relationship of the California Test of Mental Maturity Scores of South Dakota High School Freshmen to Future Academic Success

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A STATISTICAL STUDY OF THE RELATIONSHIP OF THE CALIFORNIA TEST OF MENTAL MATURITY SCORES OF SOUTH DAKOTA HIGH SCHOOL FRESHMEN TO FUTURE ACADEMIC SUCCESS

BY

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This thesis is approved as a creditable, independent investigation by a candidate for the degree, Master of Science, and acceptable as meeting the thesis requirements for this degree; but without implying that the conclusions reached by the candidate are necessarily the conclusions of the major department.

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H. A. K.

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CHAPTER I

INTRODUCTION

Purpose of the Study

Children are our charges --- theirs it is to build the nations and the races into brotherhood; theirs, to create with atom force the marvels that can be. Therefore, during this era in our civilization when increasing numbers of students are attending colleges, it seems imperative that these youngsters be guided, as early as is possible, in the direction that will enable them to ascend the educational path more easily and successfully.

In this study an attempt was made to review critically the relationship of scores on the California Test of Mental Maturity (CTMM) to the first quarter and first year grade point average in college. The CTMM was chosen because it is used at the present time in approximately 85% of the high schools throughout the state of South Dakota as part of the state wide testing service. The problem is to determine, as early as possible, whether the student is capable of handling college work. If this is possible, then the counselors or student advisors in high school can more successfully guide the students into college preparatory work or into vocational studies.

Further, an attempt was made to break the study into various groupings based on data from fifteen participating colleges in the state of South Dakota. The groupings are: Males at the School of Mines, Engineers at South Dakota State College, Male non-Engineers

at South Dakota State College, Female non-Engineers at South Dakota State College, Males at the University of South Dakota, Females at the University of South Dakota, Males at Teacher Colleges, Females at Teacher Colleges, Males at Church Colleges and Females at Church Colleges.

The purpose of the second portion of this study is to review analytically the relationship of TMF scores to high school rank, and in this way measure the accuracy in the prediction of high school rank from the CTMM scores.

The value of this section of the study, viewed singly, is difficult to assess, but, if used in association with other studies involving high school rank as a predictor of college success, it could have merit.

In this particular portion of the study the samples are divided by sex to determine whether there is a difference in predicting achievement for males and females.

To develop this study, certain hypotheses have been formulated. For clarity of analysis these hypotheses have been stated in terms of the null hypothesis. The use of this hypothesis involves the assumption that any observed differences may be attributed to chance factors.

Following are the hypotheses which will be examined:

1. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. of freshman males at School of Mines.

2. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. of freshman males at School of Mines.

3. The scores on the CTMM for freshmen high school students have no significant relationship to college grades as measured by first quarter G. P. A. of freshmen Engineers at South Dakota State College. (SDSC)

4. The scores on the CTMM for freshmen high school students have no significant relationship to college grades as measured by first year G. P. A. of freshmen Engineers at SDSC.

5. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. for college freshman male non-Engineers at SDSC.

6. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. of college freshman male non-Engineers at SDSC.

7. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for females in the non-engineering fields at SDSC.

8. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. of college freshmen for females in the non-engineering fields at SDSC.

9. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. for freshman males at USD.

10. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. for freshman males at USD.

11. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for females at USD.

12. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. for college freshmen females at USD.

13. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for males at Teacher Colleges.

14. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. in the freshman year for males at Teacher Colleges.

15. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. for freshman females at Teacher Colleges.

16. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. of college freshman females at Teacher Colleges.

17. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for males at Church Colleges.

18. The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. of college freshmen males at Church Colleges.

19. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. for freshman females at Church Colleges.

20. The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. for freshman females at Church Colleges.

21. The scores on the CTMM for freshmen high school male students have no significant relationship to high school rank as measured by each student's standing as a graduating high school senior.

22. The scores on the CTMM for freshmen high school female students have no significant relationship to high school rank as measured by each student's standing as a graduating high school senior.

THE DEFINITION OF TERMS

1. Church Colleges--This refers to all of the state's church-supported schools of higher learning.

2. Colleges--This term indicates fifteen of the sixteen institutions of higher learning in South Dakota submitting data used in this study.

3. Correlation Coefficient--A coefficient of correlation is a statistical index which indicates the relationship between two variables, such as high school grades and college grades; one of the statistical techniques for describing relationships, both positive and negative, is the product-moment correlation coefficient. This coefficient measures the degree to which two variables are associated and is symbolized by r. In terms of absolute size, r may vary from + 1.00, through zero, to - 1.00. A correlation coefficient of + 1.00 indicates a perfect positive relationship; and - 1.00 indicates a perfect negative relationship. It is very seldom, if at all, that perfect relationships are found in the behavioral sciences, in part because of the limitations of our measuring instruments and also because of the difficulties of controlling all possible factors which may influence the two variables being studied.[1]

4. Grade point average---(G. P. A.) This refers to the mathematical average of all final quarter grades received in courses taken

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[1] A. L. Edwards, Statistical Analysis, Rinehart and Company, Inc., New York, 1946.

in college when the numerical values have been assigned to the letter grades according to the following pattern: A= 4, B = 3, C = 2, D = 1, F = 0.

5. IBM Cards---This refers to the International Business Machine source cards. (See Appendix A for IBM card sample.)

6. Teacher Colleges --- This applies only to the state supported teacher training colleges located at: Aberdeen, Madison, Spearfish and Springfield, South Dakota.

DESCRIPTION OF THE CALIFORNIA SHORT-FORM TEST OF MENTAL MATURITY

The CTMM provides seven scores for the participating schools for each student tested. The manual for this test lists the following information on these scores:

Spatial Relationships —— Those who score high in these tests indicate ability to deal with maps, charts, and graphs as well as global concepts. They are oriented in space relationships. They should be able to give as well as follow directions and they should do well in planning layout design and construction.

A low score in these tests may be due to poor perception or memory or both. However, if the unsatisfactory status is due to lack of opportunity rather than ability, it may be improved through providing adequate opportunities.

Logical Reasoning —— Individuals with superior logical reasoning ability should be expected to recognize the nature and implications of problems, to distinguish between evidence and propaganda, to project and test possible solutions, and to reach valid conclusions.

When inability to reason logically is due to a remediable cause such as a very unfavorable environment over a period of years, the individual can be aided in improving his reasoning ability. However, where the environment has been favorable and he has had the commonly available opportunities, a low score usually indicates an actual lack of capacity.

Numerical Reasoning --- Individuals who score high on this test should do good thinking in arithmetic, the mathematical phases of shop work, the numerical phases of home economics having to do with recipes, problems of everyday life involving expenses, income bookkeeping, making change and the like.

If individuals who make low scores have not been denied the usual opportunities available to most people, such low scores suggest a deficiency in this factor. They frequently lack an appreciation of the significance or value of money, they must frequently be assisted in relating income to prices and expenses; much that is quantitative in their environment escapes them; and they lack definiteness and preciseness in their relations with others.

On the other hand, they may think well in the qualitative and emotional aspects of literature, music, and art, and do well in creative work which requires little or no numerical reasoning.

Verbal Concepts --- Individuals who score high in this test possess the capacity to understand and profit from their experiences. They should do well in reading, literature, and drama. They possess some of the basic abilities involved in understanding others and making others understand them; a low or average score on this test is not proof of lack of ability in the verbal factor; such a score may be due to lack of a favorable environment or training in the skills associated with this ability.

Language Factor (L) --- The language test data are particularly useful in indicating how well the individual understands relationships

expressed in words, such as instructions, conference discussions, statements of logical principles or courses of action, and the like. This is often referred to as a verbal factor.

Non-Language Factor (NL) --- The NL test data indicate how well the individual understands relationships among things or objects when no language, or a minimum amount of language is involved, such as physical or mechanical relationships.

Individuals may possess these two kinds of mental ability in very different degrees. In general, score differences between the L and NL sections may be used as follows:

1. To determine if learners need simplified programs (because of lack of ability) or remedial work.(because of failure to realize their potentialities)

2. To predict success in certain industrial arts fields.

3. To provide longitudinal (historical) data which may be of real significance in cases of change in student progress or achievement.

4. Together with factor scores, to determine the types of educational activities which will be most effective in aiding those who are experiencing learning difficulty.

Total Mental Factors Data --- (TMF) The TMF data provide many clues for helping the individual who is experiencing learning difficulties. The total score is the most reliable of all the scores, and thus must be considered as the most dependable evaluation of the individual student's ability.

The importance of sub-scores cannot be over-looked, however. Two students, with identical TMF scores, may differ markedly in their ability to handle different types of academic work.

High scores assume high ability. With high ability, we should expect a student to do well in school. Discrepancies in ability and achievement level should be given careful attention immediately. Proper counseling at the start of the high school career may salvage a student who might otherwise never develop his potential.

Low scores assume low ability. It must be realized, however, that many factors affect a particular test. Was the test properly administered? Was the student doing his best work? Were the testing conditions proper? Did the student use the right type of pencil? Can the student see properly, read properly, or hear properly? These, and many other factors, may affect the results of a test. Too much stress cannot be placed upon the importance of examining test scores in relation to these other factors.

A student with a low score may do very well in school. Such achievement may indicate that the student is an over-achiever, a student with much determination. It may indicate that the test score was not a valid indication of ability. These situations must be understood, in order for the student to be properly counseled for his road ahead.[2] (See Appendix B for a sample copy of the CTMM.)

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[2] E. T. Sullivan, W.W. Clark, and E. W. Tiegs; Manual, California Short-Form Test of Mental Maturity (Advanced, 1950, S-Form) California Test Bureau, 5916 Hollywood Boulevard, Los Angeles 28, California.

ORGANIZATION AND PROCEDURE OF THE STUDY

Following a discussion of the procedure used in gathering the data required for this study, will be an examination and review of literature related to the study. One chapter each will be devoted to the presentation and explanation of Statistical Analysis of Scores on the CTMM related to first quarter grades in college and to first year grades in college; a Statistical Analysis of Scores on the CTMM related to High School Rank. At the close of these chapters, a summary of the study and a statement of the conclusions drawn from the investigation will bring the paper to an end.

Procedure

Primarily, the procedure used in this study may be classified as statistical. The techniques employed include the use of the product-moment correlation coefficients, and appropriate tests of significance of the correlations.

The sample selected for critical evaluation was the graduating class of 1957 from high schools in the state of South Dakota. Since data were secured on nearly all students from this class who did go on to college in South Dakota, the sample should provide relatively reliable and valid norms, due to the fact that the entire state is represented.

To secure the data necessary for a study of this nature, it was important to have all, or most, of the colleges in the state cooperate. Therefore, it was decided that a person who had close

contact with the colleges of the state could most successfully reach them and obtain the required data.

Mr. Gerald Fort, Associate Professor of Student Personnel at South Dakota State College agreed to see that the colleges were contacted and to solicit the co-operation of the colleges in submitting the required data to SDSC. (See Appendix C for copy of letter sent to the colleges.)

Upon receipt of the data at the college it was organized and recorded on IBM source cards. The following information was recorded thereon: TMF scores; L scores, NL scores, both from the CTMM; First quarter G. P. A. and First year G. P. A. of the sample students as college freshmen; Sex and the High School Rank. For reasons of comparison, there was a division made between students registered as Engineers and Non-Engineers at SDSC.

Fifteen colleges from the state of South Dakota submitted data. The University of South Dakota, South Dakota State College, School of Mines, Northern State Teachers College, General Beadle State Teachers College, Black Hills State Teachers College, Southern State Teachers College, Augustana, Dakota Wesleyan University, Huron College, Sioux Falls College, Yankton College, Wessington Springs Junior College, The Presentation Academy and Mount Marty Junior College.

The test scores of the CTMM from all schools were on file at the personnel office of South Dakota State College since SDSC has the only IBM facilities available to South Dakota Schools; the data required for this study was added to the IBM cards and then the cards were used

to tabulate the various data needed for work on this problem.

CHAPTER II

REVIEW OF RELATED LITERATURE

In all testing, regardless of the existing grade level of the student, it is necessary to deal with the student as he is -- a product of certain interactions between his heredity and his environment. So far it has been difficult to isolate and measure separately these hereditary and environmental influences.

If we use them intelligently, tests can help to identify a larger number of students who are in the score ranges from which creative scientists, engineers, philosophers, historians, economists, psychologists, jurists, and educators are most likely to emerge.[3]

There have been literally hundreds of carefully conducted studies which have brought about convincing evidence of a substantial relationship between test scores and criteria of intellectual achievement as high-school grades, college grades, college graduates, graduate degrees, and occupational levels.

The specific tests, criteria, populations, time, place and other experimental characteristics will cause the amount of relationship to vary, of course.

The Association of Minnesota Colleges has been conducting an annual testing program for high-school seniors in Minnesota ever since 1928 for the purpose of providing high-school advisors with basic data

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[3] James B. Conant, "Identification and Education of the Student in the American Secondary School", National Education Association Report, February, 1958, National Education Association, 1201 Sixteenth Street S. W., Washington 6, D. C.

for selecting and encouraging capable students to enroll in college.

The question arose whether it might not be possible to begin considering this problem earlier in the school program since Senior advisors found themselves without sufficient time to encourage the able, yet undecided student and his parents to make a decision about college before the end of the school year.

Many of the studies, undertaken through the years, indicate that tests given before the senior year of high school, are valid for use in predicting college achievement.

A study by Edwin E. Vineyard seeks to relate scores obtained early in high school on the Differential Aptitude Tests (DAT), with later academic success in college.[4]

The resulting conclusions and generalizations appear to be warranted on the basis of the evidence from the study : 1. Scores on the DAT obtained at the high school freshman level offer the high school counselor useful information in assessing the advisability of higher education for the students tested. 2. Certain of the tests, particularly those involving verbal and numerical skills, were better predictors of college success than others; combinations of tests are better predictors than tests taken singly, and these combinations will predict college success with a fair degree of accuracy; and finally, tests are not of equal predictive importance for both sexes.

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[4] Edwin E. Vineyard, "A Longitudinal Study of the Relationship of Differential Aptitude Test Scores With College Success", Personnel and Guidance Journal, vol. 36, 413-416, Personnel and Guidance, 20th and North Hampton Streets, Easton, Pennsylvania.

3. The present research is somewhat unique in that it approaches the problem of prediction of general college success and success in different college curricula longitudinally, utilizing a relatively recent battery of guidance tests intending to measure differential abilities. The magnitude of the relationships found have in many instances been surprisingly strong and findings have been rather favorable in general.

This use of a battery of tests composed of a single score test of mental ability and a multiple factor test for the prediction of differential achievement at the ninth and tenth grade level appears to be justified from the results of Vineyard's study. The improvement in prediction by the inclusion of the Otis Intelligence Scale, over the prediction from single scores or combinations of Primary Mental Ability (PMA) factor scores, and also the improvement of the prediction from the Otis by including significant PMA factor scores, supports the conclusion that the counselor can make more effective predictions by employing a battery of tests rather than any single test.[5]

The purpose of this study, as I see it, is to estimate the efficiency of a single score test and a multiple factor test of mental ability as a battery for differential prediction of ninth and tenth grade achievement and the results seem to reveal the value of the battery as a tool of the counselor in assessing the long range advisability of higher education and in the selection of major college curricula.

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[5] Ibid.

Thorndike's studies have made it clear that scores from tests given at age 14 can predict, with some degree of accuracy, educational level which probably will be attained. Various investigations have shown that scores on tests given at age 14 correlate very highly with scores on similar tests given four years later.

The Junior High-School years are, it seems, an especially timely period for administering a standardized testing program. Prediction at this level is practical and appropriate in terms of the psychological development of individual youngsters and the organization of our educational system. Even though the junior-high-school years provide both an excellent opportunity and a pressing need to marshal efforts for identification of intellectual ability, it has been emphasized in the majority of the studies reviewed, that identification should be a continuous process and not confined to the junior-high-school level.

The division between the junior and the senior high schools is as crucial a period for guidance as any in the school career of youth. Counselors must aid pupils in their choice of the many and varied educational highways which confront them following the junior-high-school years.

It seems apparent that a serious limitation of much of the research carried on for the purpose of predicting college success is that they have offered prediction on the basis of measures available only at the end of the high-school years or at the beginning of the college career when it is too late to be of real value.

W. H. Billhartz, Jr. and Percival W. Hutson carried on an

investigation to explore the possibility of predicting college ability during junior-high-school years and the findings of this study suggest that the relation between scholarship standing in the junior-high-school years and later scholastic history is significant.[6]

One procedure employed in investigations was to determine the extent of correlation between a terminal test given at the end of the secondary school and intelligence tests given at various intervals prior to the terminal test.

Many investigations consistently attacked the problem of: 1. How accurately can intelligence at the time of college entrance be predicted from tests given at various earlier ages? and 2. With what weights should two or more tests, given at different times during a child's school career, be combined to give the most accurate prediction of intelligence at the time of his college entrance?

Generally, significant implications resulted from the findings which can be of value in educational practice. They indicate that insofar as the factor of intelligence is concerned, we can give a pupil relatively as accurate guidance regarding his future educational plans at the onset of his high-school course, and perhaps even in the higher elementary grades, as we are able to near the end of the course.

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[6] W. H. Billhartz, Jr. and Percival W. Hutson, "Determining College Ability During Junior-High-School Years", School and Society, vol. 53, 547-552, The Science Press, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, 1941.

The implications are that if a high school plans to give an intelligence test for use in educational guidance in and by the high school, that test should be administered early in the high-school period. The results can be expected to be as accurate for prognosis as those from a later test, and will be available for use for an extensive period of time. Further, that if more than one test has been administered to a pupil during his high-school career, the best prediction of his college-age intelligence is obtained from a simple average of the two test scores. Averaging two or more scores will yield a more reliable measurement and, if different tests are used, will tend to broaden the concept of intelligence upon which the resulting score is based.

The attempt of one study was to locate a group of individuals for whom schools had records of intelligence tests taken at various times through their school career and for whom a terminal test was available at or near the level of intellectual maturity. The latest date at which it seemed practical to find tests on a large population was college entrance, so this was chosen as the time for the terminal test, and the Scholastic Aptitude Test was selected for this purpose.

The next step of the investigation involved the location of pupils who had taken the Scholastic Aptitude Test and for whom there existed a fairly rich record of earlier testing too. It was, of course, necessary to check all test records for errors and inconsistencies. After taking care of the required mechanical details, it was necessary

to reduce all occurrences of the same test to comparable form.[7]

In general, the aim of the foregoing study, was to get a reasonably substantial body of data for certain frequently occurring tests. From a study of the prepared tables accompanying this study, it seemed apparent that there was no clear relationship between time interval and accuracy of prediction of terminal test scores.

Many of the intelligence tests, cited in the literature studied, give three scores or intelligence quotients. In addition to the total mental factors or the single I. Q. there usually are two component parts for which separate scores are given. These are verbal (language) and nonverbal (quantitative, performance or nonlanguage). Research studies show that the verbal scale is a better predictor than the nonverbal score.

G. M. Fort, Associate Professor at South Dakota State College used the CTMM to develop a statistical analysis of the correlation of a test and a retest; this was used to determine whether there was a high correlation between scores on the first and second tests.[8]

Correlation coefficient for the L score was .6179; NL score .3644 and TMF score .6640; all which indicate there was a high correlation between language factors; rather poor correlation between nonlanguage factors and finally, a high correlation between TMF scores.

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[7] R. L. Thorndike, "The Prediction of Intelligence at College Entrance from Earlier Tests", Journal of Educational Psychology, vol. 38, 129-148, Warwick and York, Inc., Baltimore, Maryland, 1947.

[8] G. M. Fort, "Test-Retest Reliability Study of CTMM", South Dakota Guidance Newsletter, September, 1954.

The discoveries made in this reliability study seem to bear out the information from preceding studies; the NL factor is the least reliable as a predictor.

A study was made by Carlson and Milstein to determine those aspects of the high school record which are most closely related to college grade point average, since it was believed that a finer breakdown of this record might afford a better prediction of the criterion.[9] First quarter G. P. A. was used as the criterion because it has been shown that the best predictor of later college performance has been earlier achievement.

It becomes apparent that a rating, to be most efficient, needs to meet a number of standards: 1. It should predict with the greatest possible accuracy later college performance, generally, or in specific areas. 2. It should have a college frame of reference in that it must relate to performance in the particular institution. (It must have college population norm.) 3. It should minimize differences between high schools, the rating should be a function of the student's performance and not of his particular school's standards of grading. 4. It should minimize differences between the various types of high school curricula; and should be adaptable to rapid and accurate computation. 5. It should be a form amenable to statistical analysis and because public endorsement of the policies of any institution is important, it should be comparatively easy to understand and to accept.

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[9] J. S. Carlson and V. Milstein, "The Relation of Certain Aspects of High School Performance to Academic Success in College", Journal of American Association of Collegiate Registrars and Admissions Officers, vol. 33, No. 2, 185-192, Winter, 1958, Association Publication, Allentown, Pennsylvania.

Due to the emphasis on the "Space-Age" a great deal of research has been done on single tests and measures such as high school averages in attempts to find combinations of these variable which would predict success in engineering training, since so many youth have become vitally interested in this field.

Previous school achievement is generally found to be the best predictor of later achievement, and Stuit, Dickson and Jordan in a summary of engineering prediction report studies found that on the average, coefficients of correlation in the neighborhood of .55 existed between high school achievement and first-year grades in college engineering. In addition, coefficients of correlation between scholastic aptitude tests and engineering grades are reported as being about .45; mechanical and spatial aptitude tests correlate about .35 with grades in engineering. Science aptitude tests correlate approximately .45 while mathematics aptitude tests move up to a correlation of nearly .50 to .55 with grades in engineering. Physics, chemistry and science achievement tests correlate about .45 to .50 and English achievement tests correlate near .40 to .45 with grades for the first year in engineering.

The high school average plus one or two tests have received the most weight; multiple correlations average about .65 in the reported studies. [10]

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[10] Wilbur L. Layton, "Predicting Engineering Grades", Selection and Counseling of Students in Engineering Manual, University of Minnesota Press, Minneapolis, Minnesota, 1954.

The University of Minnesota indicates, from recent studies, that when all variables were combined, the resulting coefficient of multiple correlation was .82. Further study was assumed necessary to improve a newly developed Engineering Aptitude test. This is a new approach in this area and needs more research to prove and improve its worth.

Generally, the high school average, mathematics tests and aptitude tests (given upon entrance into college) were the best predictors of grades in engineering.

The usual trends of these coefficients of correlation are important. From tables studied of predictive relationships, it was seen that general achievement tests at the end of the high-school course are more prognostic of general college scholarship than general mental tests. Individual tests of specific traits, aptitudes and achievements are lowest of all for this purpose.

Predictive correlation coefficients using average high-school marks are more variable than coefficients obtained through the use of general scholastic aptitude or general-achievement tests.

It has been noted that the coefficient of correlation, when college success is predicted from average high-school marks, is higher than the corresponding coefficient obtained when general mental test scores are used.

It is apparent that for predicting general college scholarship the best tests are those testing general achievement, and for predicting scholarship in specific college subjects, tests of specific aptitudes

or achievements are the best.

There are several articles in published form dealing with frequency of test usage in counseling centers. In all articles reviewed, the ACE Psychological Examination for College Freshmen and the CTMM have ranked high as tests of intelligence and predictors of college success.

S. F. Klugman conducted a study to determine the degree to which the ACE and CTMM agree with each other, since both purport to predict academic success in college. His study sought to ascertain whether the observed percentile differences are significant for total, verbal, and nonverbal scores. Mr. Klugman sought also to determine the degree of correlation existing between the tests for the three scores, for this investigation. Thus, reliability of mean differences and size of r were used as measures of agreement.

The findings of this study disclosed that: 1. The obtained product-moment correlations between the verbal, nonverbal and total scores of both tests were not significantly different. 2. The verbal scores yielded the highest product-moment r; the total scores a slightly lower r and the r for nonverbal scores was the lowest. The differences between verbal and nonverbal r's were significant. 3. There was no significant mean difference between the verbal scores of the two tests. 4. There were significant mean differences at the 0.01 level between the two tests for nonverbal and total scores. It was felt by the investigator that the difference between total scores was a reflection

of the difference between the nonverbal scores.[11]

The total score findings, of this study, emphasize the need for reporting in test manuals not only validity coefficients, but also comparable mean data for the samples used, to facilitate interpretation and prediction of results.

Studies are consistent in indicating that college failure can be predicted with a considerable degree of accuracy, and scholastic achievement, as well as aptitude for successful college work can be pointed out with reasonable accuracy.

Quite often two factors are combined into a formula to predict achievement. They are the psychological test given in the senior year of high school and the student's rank in his high school class; also converted into a percentile rank.

It has been discovered that this formula has fallen short of its potential value, from the point of view of its educational guidance, because data used is not available until within a few months of the time the students enter college; therefore, the premise, that to be of practical value for guidance workers, the prediction of college achievement must be moved back in the school life of the pupil, emerges once again.

Volumes of research on the problem of prediction show that there is no single predictor that can be used with any high degree of certainty. There are many factors that give a good indication, however,

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[11] Samuel F. Klugman, "Agreement Between Two Tests As Predictors of College Success", Personnel and Guidance Journal, vol. 36, 255-258, Personnel and Guidance Journal, 20th and North Hampton Streets, Easton, Pennsylvania, 1957.

when considered as a total pattern, rather than as isolated elements. Standing in the high school graduating class has long been a favorite predictor for college admission officers. The intelligence quotient also has been widely used, as well as achievement tests and inventories of various types.

The rank in the high school graduating class seems to be recognized as the best single predictor for success in college. Some studies have shown that rank in class is important even though some students take a college preparatory course and others do not. It appears that success in high school, regardless of the courses selected, or the size of the high school class, is a fairly consistent predictor for success in college. Additional investigations point out that a rank determined by using only the grades from the courses required for college entrance (English, mathematics, history) is a better predictor than is the grade point average of all subjects.

A related study, which was attempting to discover what happens to high school seniors following graduation was carried out by a research committee from the South Dakota Guidance and Public Relations Associations.[12]

A percentage break-down for establishing what all the students do after graduation was given, and then the top group was considered.

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[12] L. R. Palmerton, G. M. Fort and Don Scannell; "The High School Seniors of 1957---Where Are They in 1958?", South Dakota Education Association Journal, April, 1958.

"Top group" was determined by measuring ability (through the use of the School and College Ability Test) and by achievement (rank) in class.

The tables accompanying this study give a graphic picture of comparisons for the total group as well as for the sub-divisions of the group.

There is a strikingly obvious female superiority in achievement, as shown by this survey. Though abilities were comparable, the girls achieved better than their male contemporaries.

A conclusion reached after this examination of related literature is that to be of practical value for guidance workers, the prediction of college achievement must be moved back in the school life of the pupil. From the investigations of the possibilities of long-range prediction it may be concluded that intelligence tests taken early in the school career have a definite value as a predictive measure of a pupil's ability to do successful work in college.[13]

Tests are by no means infallible but they provide a highly serviceable degree of accuracy. Properly understood and properly used, tests offer a potent aid in the selection, guidance or placement of students.

Counselors, however, cannot be expected to make the most efficient use of test results through interpretation, until data which will show the degree of association of the results (from a test or tests) with objective external criteria, is made available.

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[13] Ruth Byrn, V. A. C. Henmon, "Long-Range Prediction of College Achievement", School and Society, vol. 41, 877-880, The Science Press, North Queen Street and McGovern Avenue, Lancaster, Pennsylvania, 1935.

CHAPTER III

A STATISTICAL ANALYSIS OF THE CALIFORNIA TEST OF MENTAL MATURITY SCORES AS RELATED TO COLLEGE GRADE POINT AVERAGE

The evaluation, of the 1957 high school graduates in South Dakota who attended colleges in the state, served as the determining guide for computation of data for this chapter in the study.

This portion presents findings for the prediction of college grade point averages from test scores of the CTMM.

To facilitate handling of data, the samples for this study were divided into college groups; students at the School of Mines, South Dakota State College, University of South Dakota, Teacher Colleges and Church Colleges.

For more specific identification, sub-divisions were made of the above groupings as to sex, and the male students at SDSC were divided into engineering and non-engineering categories.

To develop any findings, it was essential that the coefficients of correlation of G. P. A. to CTMM scores be computed for the groups stated above.

Following is the form for the product-moment correlation formula used:[14]

$$r_{xy} = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{N\Sigma X^2 - (\Sigma X)^2}\sqrt{N\Sigma Y^2 - (\Sigma Y)^2}}$$

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[14] A. L. Edwards, Statistical Analysis, Rinehart and Company, Inc., New York, 1946.

Correlation coefficients have no meaning unless the significance of the magnitude of the coefficient is determined. For these product-moment correlation coefficients, TABLE I, which is a test for independence, was used.

TABLE I. PERCENTILES OF THE DISTRIBUTION OF THE CORRELATION COEFFICIENT

N	5%	1%	N	5%	1%	N	5%	1%
10	.632	.765	30	.361	.463	50	.279	.361
12	.576	.708	32	.349	.449	60	.254	.330
14	.532	.661	34	.339	.436	70	.235	.306
16	.497	.623	36	.329	.424	80	.220	.287
18	.468	.590	38	.320	.413	100	.197	.256
20	.444	.561	40	.312	.403	150	.161	.210
22	.423	.537	42	.304	.393	200	.139	.182
24	.404	.515	44	.297	.384	400	.098	.128
26	.388	.496	46	.291	.376	1,000	.062	.081
28	.374	.479	48	.284	.368			

[15]

TABLE I gives critical values of r for the 5% and 1% levels of significance under the assumption that X and Y have independent normal distributions. For example, in using a sample of 50 observations, if the observed r is larger than .279 or less than - .279 we should reject the hypothesis that p = 0 at the 5% level of significance.

TABLE I will be used to check the significance of the correlation

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[15] W. J. Dixon and F. J. Massey, Jr., "Regression and Correlation", Introduction to Statistical Analysis, p. 164, McGraw-Hill Book Company, Inc., 1951.

coefficients of each hypothesis (as stated in Chapter I) at the 5% level through the remainder of this chapter, although some of the correlations will be significant at the 1% level. The accepting or rejecting of the hypothesis will be at the 5% level only.

Correlation coefficients were computed for TMF, L and NL of the CTMM and first quarter G. P. A. of students at each of the co-operating South Dakota Colleges. The results of the computation are shown on TABLES II and III. TABLE II indicates the correlation coefficients for male students and TABLE III indicates correlation coefficients for the female students.

TABLE II. CORRELATIONS BETWEEN SCORES ON CTMM AND FIRST QUARTER G. P. A. OF MALES IN SOUTH DAKOTA COLLEGES

School	N	TMF	L	NL
School of Mines	145	.274 **	.245 *	.231 *
SDSC-Eng.	83	.332 **	.260 *	.275 *
SDSC	146	.366 **	.368 **	.218 *
USD	105	.357 **	.355 **	.200 *
Teacher Colleges	198	.277 **	.301 **	.129
Church Colleges	131	.356 **	.353 **	.230 *

* Significant at 5% level
** Significant at 1% level

TABLE III. CORRELATIONS BETWEEN SCORES ON CTMM AND FIRST QUARTER G. P. A. OF FEMALES IN SOUTH DAKOTA COLLEGES

School	N	TMF	L	NL
SDSC	128	.283 **	.249 *	.188
USD	81	.400 **	.405 **	.280 *
Teacher Colleges	253	.278 **	.297 **	.168 *
Church Colleges	195	.307 **	.300 **	.221 **

* Significant at 5% level
** Significant at 1% level

Through careful observation of TABLES II and III it becomes apparent that the levels of significance vary appreciably between TMF, L and NL factors. The TMF and L factors are most significant, indicating a positive relationship to first quarter grades, whereas there seems to be little relationship between the NL factor and first quarter grades. This bears out the fact (stated in the Review of Related Literature) that NL scores are of little value in prediction studies.

Next, correlations were tabulated for TMF, L and NL of the CTMM and first year G. P. A. for students at the same South Dakota Colleges. TABLES IV and V show the results. The coefficients for male students are shown on TABLE IV. TABLE V indicates coefficients for female students.

It will be noted that the quantity of students in the samples on TABLES IV and V is less than preceding TABLES II and III, because a number of students dropped out of college after the first quarter.

TABLE IV. CORRELATIONS BETWEEN SCORES ON CTMM AND FIRST YEAR G. P. A. OF MALES IN SOUTH DAKOTA COLLEGES

School	N	TMF	L	NL
School of Mines	120	.292 **	.295 **	.200 *
SDSC-Eng.	78	.269 *	.281 *	.219
SDSC	120	.478 **	.365 **	.253 *
USD	94	.291 **	.252 *	.098
Teacher Colleges	171	.218 **	.269 **	.105
Church Colleges	119	.381 **	.404 **	.201 *

* Significant at 5% level
** Significant at 1% level

TABLE V. CORRELATIONS BETWEEN SCORES ON CTMM AND FIRST YEAR G. P. A. OF FEMALES IN SOUTH DAKOTA COLLEGES

School	N	TMF	L	NL
SDSC	118	.323 **	.273 **	.228 *
USD	78	.575 **	.553 **	.431 **
Teacher Colleges	236	.444 **	.436 **	.306 **
Church Colleges	176	.372 **	.420 **	.192 *

* Significant at 5% level
** Significant at 1% level

The next step in this study is the consideration of Hypothesis 1 as stated in Chapter I:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. of freshman males at School of Mines.

The correlation coefficient between the TMF score of the CTMM and first quarter grades is $+ .274$. This coefficient of correlation was significant at the 5% level. Therefore, the null hypothesis can be rejected since such a relationship could have existed by chance five in one hundred times.

Consideration of Hypothesis 2, as stated in Chapter I, follows:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. of freshman males at School of Mines.

The correlation coefficient between the TMF score of the CTMM and first year grades is $+ .292$. This coefficient of correlation was significant at the 5% level. Thus, the null hypothesis can be rejected.

Hypothesis 3, as stated in Chapter I, reads:

> The scores on the CTMM for freshmen high school students have no significant relationship to college grades as measured by first quarter G. P. A. of freshmen Engineers at SDSC.

The correlation coefficient between the TMF score of the CTMM and first quarter grades was $+ .332$. This coefficient of correlation was significant at the 5% level. Therefore, the null hypothesis can be rejected.

Next in line for consideration is Hypothesis 4 as stated in Chapter I:

The scores on the CTMM for freshmen high school students have no significant relationship to college grades as measured by first year G. P. A. of freshmen Engineers at SDSC.

The correlation coefficient between the TMF score of the CTMM and the first year grade was + .269. This coefficient of correlation was significant at the 5% level. Therefore, the null hypothesis can be rejected.

As the examination of these four hypotheses is concluded it seems apparent that the TMF and L scores are the most reliable as predictors because they are both significant at the 5% level and in some instances are positive at the 1% level also.

The NL score shows a rather poor correlation. (It is barely significant at the 5% level for School of Mines and no significance at all is registered at the 5% level for SDSC-Engineers for the first year.)

Therefore, it may be concluded that the relationship of CTMM scores and first quarter and first year grades of Engineers at the School of Mines and SDSC is so slight that the difference may be discounted as unimportant.

The next four hypotheses involve students at South Dakota State College who were enrolled in non-engineering courses.

First for consideration is Hypothesis 5 as stated in Chapter I;

The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. for college freshman male non-Engineers at SDSC.

The correlation coefficient between the TMF score of the CTMM and the first quarter grade was $+ .366$. At the 5% level this correlation coefficient was significant, and so the null hypothesis can be rejected.

Hypothesis 6, as written in Chapter I, states:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. of college freshman male non-Engineers at SDSC.

The correlation coefficient between the TMF score of the CTMM and the first quarter grade was $+ .478$. This correlation coefficient was significant at the 5% level; so the null hypothesis can be rejected.

Following is Hypothesis 7, as stated in Chapter I:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for females in the non-engineering fields at SDSC.

A $+ .283$ was the correlation coefficient between the TMF score of the CTMM and the first quarter grade. At the 5% level, this correlation coefficient was significant, so the null hypothesis was rejected.

Hypothesis 8, as stated in Chapter I, says:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. of college freshmen for females in the non-engineering fields at SDSC.

A correlation coefficient of $+ .323$ between the TMF score of the CTMM and the first year grade proved significant at the 5% level. Thus, the null hypothesis can be rejected.

The TMF score was used to test Hypotheses five, six and also seven and eight; it was significant in all cases. The L and NL scores were significant too, at the 5% level, with one exception; that of the females in attendance at SDSC for the first quarter.

There is very little difference between the correlation of the first quarter and first year grades for males and females at SDSC who enrolled in the non-engineering courses.

For the next group of hypotheses, which includes nine, ten, eleven and twelve, students from the University of South Dakota were considered.

First, Hypothesis 9, as stated in Chapter I:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. for freshman males at USD.

The correlation coefficients between the TMF score of the CTMM and the first quarter grade was $+ .357$. The null hypothesis can be rejected, because this correlation coefficient was significant at the 5% level.

Next is Hypothesis 10, as written in Chapter I, which states:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. for freshman males at USD.

The correlation coefficient of $+ .291$ between the TMF score of the CTMM and the first year grade was significant at the 5% level; therefore, the null hypothesis can be rejected.

Third to be considered, in this group, is Hypothesis 11 as stated in the first chapter:

The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for females at USD.

A + .400 correlation coefficient between the TMF score of the CTMM and the first quarter grades was significant at the 5% level and so the null hypothesis can be rejected again.

The next hypothesis for consideration is Hypothesis 12 as stated in Chapter I:

The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. for college freshmen females at USD.

A correlation coefficient of + .575 between the TMF score of the CTMM and the first year grades was significant at the 5% level; therefore the null hypothesis can be rejected.

Again the TMF score was used to test Hypotheses nine, ten, eleven and twelve and proved significant in all cases. Males who were enrolled at the University of South Dakota, for the first year, were the exception to significance at the 5% level on the NL score. There seems to be a relatively high correlation between CTMM scores and college grades for females at USD.

The following four hypotheses will consider males and females from the four teacher colleges in South Dakota.

Hypothesis 13, as written in Chapter I, states:

The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for males at Teacher Colleges.

The coefficient of correlation between the TMF score of the CTMM and the first quarter grade was + .277. At the 5% level this correlation coefficient was significant; therefore the null hypothesis can be rejected.

The next hypothesis, which is Hypothesis 14, follows, as it was written in Chapter I:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. in the freshman year for males at Teacher Colleges.

The + .218 correlation coefficient between the TMF score of the CTMM and the first year grade was significant at the 5% level. Once again the null hypothesis can be rejected due to this significance.

Hypothesis 15, as written in Chapter I, states:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. for freshman females at Teachers Colleges.

The correlation coefficient between the TMF score of the CTMM and the first quarter grade was + .278. This correlation coefficient was significant at the 5% level; therefore the null hypothesis can be rejected.

As written in Chapter I, Hypothesis 16 states:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. of college freshman females at Teacher Colleges.

The null hypothesis can again be rejected due to the fact that the correlation coefficient between the TMF score of the CTMM and the first year grade was + .444, which is significant at the 5% level.

Observation indicates significance at all levels except on the male NL score for the first quarter and first year. Also, correlations for TMF, L and NL scores were significant at the 1% level for females in Teacher Colleges at the close of the first year.

The remaining four hypotheses in this chapter test the significance of TMF scores and the grade point averages for students enrolled at the eight church-supported colleges and junior colleges used in this sample.

To begin this final examination of hypotheses, consider Hypothesis 17, as stated in Chapter I:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first quarter G. P. A. in the freshman year for males at Church Colleges.

The correlation coefficient between the TMF score of the CTMM and the first quarter grade was $+ .356$. This correlation coefficient was significant at the 5% level; therefore the null hypothesis can be rejected.

Hypothesis 18, as written in Chapter I, states:

> The scores on the CTMM for freshmen high school males have no significant relationship to college grades as measured by first year G. P. A. for freshman females at Church Colleges.

A $+ .381$ correlation coefficient between the TMF score of the CTMM and the first quarter grade was significant at the 5% level. Thus the null hypothesis can once more be rejected.

Next is Hypothesis 19, as written in Chapter I, it reads:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first quarter G. P. A. for freshman females at Church Colleges.

The correlation coefficient between the TMF score of the CTMM and the first quarter grade was + .307. The null hypothesis can be rejected since this correlation coefficient was significant at the 5% level.

The final hypothesis, for consideration here, is Hypothesis 20, as written in Chapter I:

> The scores on the CTMM for freshmen high school females have no significant relationship to college grades as measured by first year G. P. A. for freshman females at Church Colleges.

The correlation coefficient between the TMF score of the CTMM and the first year grade was + .372 and was significant at the 5% level; therefore, the null hypothesis can be rejected.

All coefficients are significant at the 5% level for the Church College group. The TMF and L scores are also significant at the 1% level. The NL score appears to be of the least value in prediction studies. The L score was consistently significant at the 5% level, but its consistency did drop somewhat at the 1% level.

For prediction studies, the TMF score is the most useful, because it provides correlation coefficients significant at the 1% level in all but one of the samples examined. This indicates that a comprehensive test gives a more accurate analysis for prediction than the single portions of the test.

To utilize the correlation coefficients brought out by the examinations of the hypotheses, the coefficient must be used in the interpretation of a test score. An individual's performance must be quantified in some way, and then compared to a like quantified

performance of a group. Without a standard of reference, a test score remains meaningless. In order to ascribe meaning to the TMF score of an individual on the CTMM, it must be compared with the scores of a known group. To do this, first, it is necessary to locate the mean score of the group by dividing the sum of the total scores by the number of cases in the sample. In this way the means were calculated for the TMF and first quarter and first year G. P. A.

In addition, it is necessary to know about the variability of the group, or how the people differ from the mean. If all members of a group obtain scores closely similar to the typical score, the variability is small. If wide differences are found within the group the variability is large.

The most effective statistic which summarizes this variability is the Standard Deviation, (S. D.) The S. D. for the above means was found by use of the following formula:

$$\sigma_X = \frac{\sqrt{N\Sigma X^2 - (\Sigma X)^2}}{N}$$

where X = the total score of the sample
N = the number of cases in the sample

The calculated means and the S. D. for TMF and G. P. A. are shown in TABLES VI, VII, VIII and IX.

TABLE VI. MEANS AND STANDARD DEVIATIONS OF TMF SCORES AND FIRST QUARTER G. P. A. FOR MALES IN SOUTH DAKOTA COLLEGES

School	N	TMF		First Quarter G. P. A.	
		Mean	S. D.	Mean	S. D.
School of Mines	145	69.25	10.60	2.28	.77
SDSC-Eng.	83	68.72	10.02	2.29	.86
SDSC	146	64.71	9.64	1.77	.93
USD	105	64.63	8.92	1.88	.98
Teacher Colleges	198	61.62	9.63	2.08	.72
Church Colleges	131	64.16	10.86	1.95	.80

TABLE VII. MEANS AND STANDARD DEVIATIONS OF TMF SCORES AND FIRST QUARTER G. P. A. FOR FEMALES IN SOUTH DAKOTA COLLEGES

School	N	TMF		First Quarter G. P. A.	
		Mean	S. D.	Mean	S. D.
SDSC	128	65.68	9.69	2.42	.76
USD	81	66.29	11.36	2.51	.90
Teacher Colleges	253	60.43	11.06	2.44	.71
Church Colleges	195	62.46	11.15	2.37	.84

TABLE VIII. MEANS AND STANDARD DEVIATIONS OF TMF SCORES AND FIRST YEAR G. P. A. FOR MALES IN SOUTH DAKOTA COLLEGES

School	N	TMF		First Year G. P. A.	
		Mean	S. D.	Mean	S. D.
School of Mines	120	70.09	11.73	2.3	.58
SDSC-Eng.	78	68.05	9.69	2.23	.72
SDSC	120	64.9	10.05	1.98	.75
USD	94	65.0	8.99	2.11	.78
Teacher Colleges	171	61.98	9.68	2.13	.58
Church Colleges	119	64.36	10.88	2.09	.64

TABLE IX. MEANS AND STANDARD DEVIATIONS OF TMF SCORES AND FIRST YEAR G. P. A. FOR FEMALES IN SOUTH DAKOTA COLLEGES

School	N	TMF		First Year G. P. A.	
		Mean	S. D.	Mean	S. D.
SDSC	118	65.96	9.71	2.5	.62
USD	78	66.0	11.44	2.60	.75
Teacher Colleges	236	60.39	11.01	2.49	.59
Church Colleges	176	62.93	10.26	2.49	.63

Once the differences and relationships of scores and G. P. A. have been discovered and measured by the statistical techniques discussed, an attempt can be made to predict G. P. A. averages based upon these discoveries and measurements.

To accomplish this, a regression coefficient must be established, and then the regression coefficient is substituted into a regression formula.

The regression coefficient was computed in accordance with the following formula:

$$b_{yx} = r \frac{\sigma_y}{\sigma_x}$$

where r = Correlations coefficient of TMF and G. P. A.
σ_y = S. D. of G. P. A.
σ_x = S. D. of TMF score

When the regression coefficient is computed, it may then be substituted into the following regression equation:[16]

$$y' = b_{yx} (X - M_x) + M_y$$

where y' = the predicted G. P. A.
b_{yx} = the regression equation
X = the TMF score
M_x = the mean of TMF
M_y = the mean of G. P. A.

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[16] A. L. Edwards, "Prediction and the Evaluation of Predictions" Statistical Analysis, p. 265, Rinehart and Company, Inc., New York, 1946.

To avoid substracting M_x from X each time that a prediction is made, the regression formula may be rewritten in the following way.[17]

$$y' = b_{yx} X + k$$

where $k = M_y - b_{yx} M_x$

From the preceding formulas the following prediction equation tables were developed to estimate first quarter and first year G. P. A. for males and females in South Dakota Colleges.

TABLE X. REGRESSION EQUATIONS FOR PREDICTING FIRST QUARTER G. P. A. FOR MALES IN SOUTH DAKOTA COLLEGES

School	Regression Equation	Standard Error of Estimate
School of Mines	$y' = .0201 X + .89$	$\pm .74$
SDSC--Eng.	$y' = .0284 X + .34$	$\pm .81$
SDSC	$y' = .0352 X - .50$	$\pm .86$
USD	$y' = .0391 X - .64$	$\pm .91$
Teacher Colleges	$y' = .0206 X + .82$	$\pm .69$
Church Colleges	$y' = .0262 X + .27$	$\pm .74$

[17] A. L. Edwards, "Predictions and the Evaluation of Predictions", Statistical Analysis, p. 265, Rinehart and Company, Inc., New York, 1946.

TABLE XI. REGRESSION EQUATIONS FOR PREDICTING FIRST QUARTER G. P. A. FOR FEMALES IN SOUTH DAKOTA COLLEGES

School	Regression Equation	Standard Error of Estimate
SDSC	$y' = .0221 X + .97$	$\pm .73$
USD	$y' = .0316 X + .42$	$\pm .82$
Teacher Colleges	$y' = .0178 X + 1.37$	$\pm .68$
Church Colleges	$y' = .0231 X + .93$	$\pm .80$

TABLE XII. REGRESSION EQUATIONS PREDICTING FIRST YEAR G. P. A. FOR MALES IN SOUTH DAKOTA COLLEGES

School	Regression Equation	Standard Error of Estimate
School of Mines	$y' = .0144 X + 1.30$	$\pm .55$
SDSC-Eng.	$y' = .0193 X + .92$	$\pm .69$
SDSC	$y' = .0356 X - .33$	$\pm .66$
USD	$y' = .0252 X + .48$	$\pm .85$
Teacher Colleges	$y' = .0130 X + 1.33$	$\pm .56$
Church Colleges	$y' = .0224 X + .65$	$\pm .59$

TABLE XIII. REGRESSION EQUATIONS PREDICTING FIRST YEAR G. P. A. FOR FEMALES AT SOUTH DAKOTA COLLEGES

School	Regression Equation	Standard Error of Estimate
SDSC	$y' = .0206\ X \pm 1.15$	$\pm .58$
USD	$y' = .0376\ X \pm .12$	$\pm .61$
Teacher Colleges	$y' = .0237\ X \pm 1.09$	$\pm .53$
Church Colleges	$y' = .0228\ X \pm 1.06$	$\pm .58$

To illustrate the use of the regression equation, let us predict the first year G. P. A. for a high school male interested in attending School of Mines. By referring to TABLE XII, the formula to calculate first year G. P. A. is obtained:

$$y' = .0144\ X \pm 1.30$$

Assume that his TMF score on the CTMM was 72. Substituting this value for X in the above formula, the value for y' is found:

$$y' = .0144\ (72) \pm 1.30$$
$$= 1.04 \pm 1.30$$
$$= 2.34$$

The extent of error in prediction, i.e., the degree to which the predicted y' fails to correspond to the actual G. P. A. this

high school boy would receive, is indicated by the standard error of estimate.

Stated in terms of the formula it is:[18]

$$\sigma_{y \cdot x} = \sigma_y \sqrt{1 - r^2}$$

where σ_y = S. D. of G. P. A.

r = Correlation Coefficient

The foregoing equation was used to procure the standard error of estimate found in TABLES X, XI, XII and XIII. Thus, the standard error of estimate for the preceding example would be $\pm$ .55 which gives his predicted G. P. A. for the first year, a range of 1.79 to 2.89.

Heretofore, the chapter has been devoted to the analysis and prediction of G. P. A. of students (divided by sex) in the specific colleges in South Dakota. A related tabulation, TABLE XIV, exhibits the chances in 100 for getting grades of D or below, C or better, B or better for all students, regardless of sex or of college attended. The information within this table is based on the grades received by the 1,314 students under consideration in this study.

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[18] A. L. Edwards, "Predictions and the Evaluation of Predictions", Statistical Analysis, p. 268, Rinehart and Company, Inc., New York, 1946.

TABLE XIV. GRADES RELATED TO TMF SCORES BASED ON CHANCES PER 100

TMF Scores	D or below	C or better	B or better
30-39	57	43	0
40-49	43	57	7
50-59	43	57	9
60-69	31	69	14
70-79	20	80	31
80-89	14	86	40
90-100	9	91	73

By careful examination of TABLE XIV, it is observed that a student whose TMF score falls between 30-39 will get a C or better about 43 times in 100, and D or below 57 times in 100. A student's chance of getting a B or better increases as the TMF score becomes larger.

As this chapter is concluded, it should be noted that certain factors became evident with the development of the chapter.

As already stated, the correlation coefficient of TMF scores and G. P. A. is the most significant; showing consistently positive significant relationships to G. P. A.; L scores indicate positive relationship, but less consistently than TMF. The NL factor shows poor relationship to G. P. A., so is of little value in this prediction study.

Regarding the males of the sample, there was a noticeable difference in means of the TMF scores. The School of Mines had the highest mean, followed by SDSC-Engineers (a close second). The Teacher Colleges had the lowest means of TMF scores of all samples included in the study.

For the females included in the sample, South Dakota University females showed the highest TMF means; they were followed closely by the female students enrolled at South Dakota State College. Again the Teacher Colleges were lowest.

Also observed was the fact that the mean of first quarter grades was lower than the mean of first year grades in nearly every case tested. The number of cases in the sample at the end of the first year is slightly less than the number after the first quarter. The increase, then, in the mean of first year G. P. A. could be attributable in part, to the fact that many of the poorer students dropped from school after the first quarter.

In summarizing the regression equations developed in this chapter, it may be noted that the standard error of estimates pertinent to these equations dropped considerably from the first quarter to the end of the first year. This reduced error of estimates could be attributed to the fact that the students became acclimated to the college work and to the environment; also, many of the poorer students dropped from school after the first quarter leaving a group which did more consistent work.

CHAPTER IV

A STATISTICAL ANALYSIS OF THE CALIFORNIA TEST OF MENTAL MATURITY SCORES AS RELATED TO HIGH SCHOOL RANK

Standing or rank in the high school graduating class has long been the favorite predictor of future academic achievement, therefore, the prediction of high school rank from TMF scores on the CTMM could be important. The high school advisor or counselor, by utilizing the TMF scores, could predict the student's high school rank and determine from the prediction, whether the student was achieving acceptably.

Chapter III employed the correlation coefficient as a test for the twenty hypotheses presented for examination. The correlation coefficient was used to get proof of whether there was a significant relationship between the CTMM scores and G. P. A. of students in this sample.

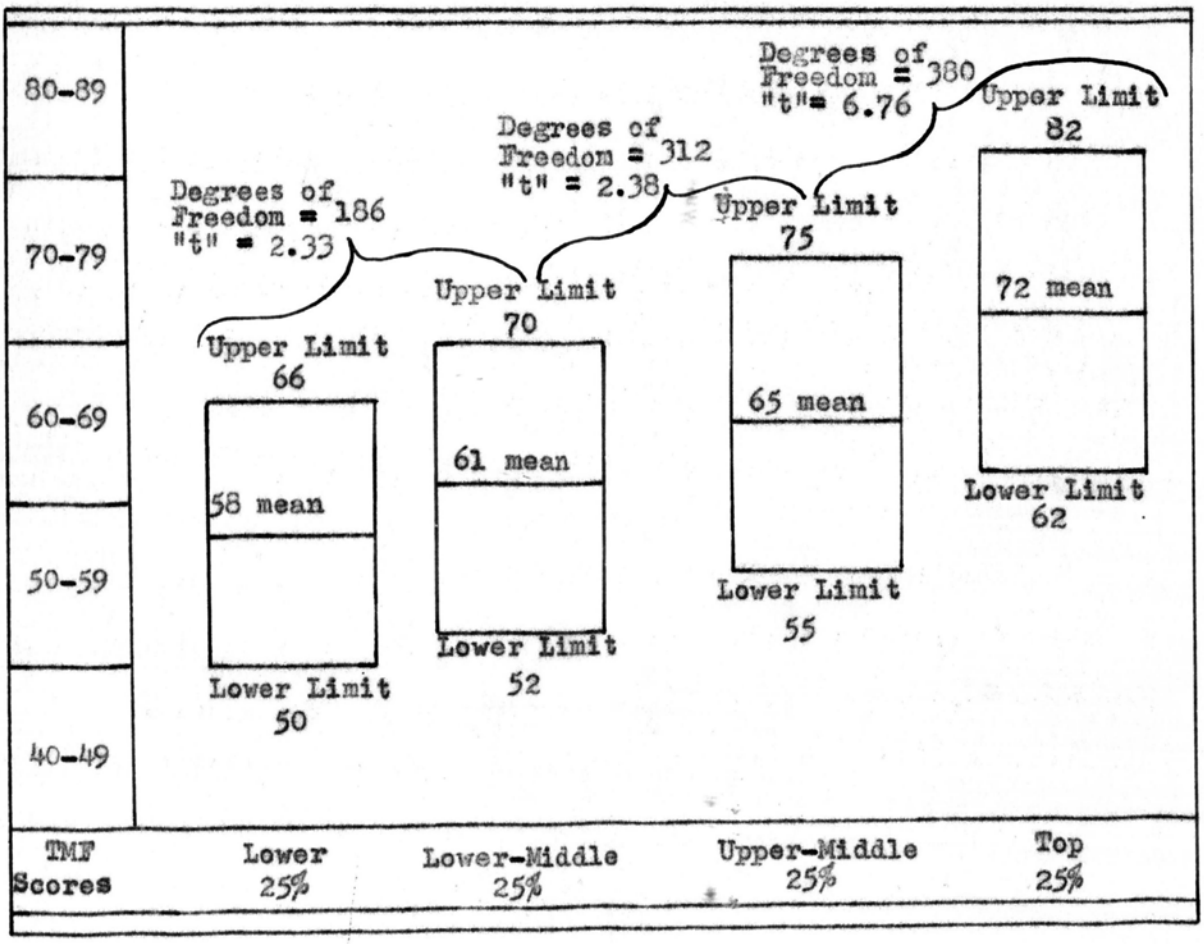
Chapter IV, in place of determining the correlation coefficient between high school rank and TMF scores, tested the significance of Hypotheses 21 and 22 by means of inspection and critical analysis of TABLES XV and XVI, which were used as a basis for accepting or rejecting the null hypothesis.

The total sample used here consists of 1078 students. This number is smaller than the sample in the preceding chapter because only students with a high school rank can be used in this analysis, and a number of cooperating schools did not have high school rank available for inclusion on their data.

Only the mean TMF score and the S. D. of each mean were calculated for the lower 25%, the lower-middle 25%, the upper-middle 25%, and the top 25% of the students in this sample. The relationship of TMF scores to high school rank for males in South Dakota high schools may be established by a study of the graph which follows Hypothesis 21 as stated in Chapter I:

> The scores on the CTMM for freshmen high school male students have no significant relationship to high school rank as measured by each student's standing as a graduating high school senior.

TABLE XV. MEAN AND A TWO S. D. BELT-RANGE OF HIGH SCHOOL RANK AS RELATED TO TMF SCORES FOR MALES IN SOUTH DAKOTA HIGH SCHOOLS



A "t" test for determining the significance of the difference between the means of the high school groups was applied, and is expressed by the following formula:[19]

$$t = \frac{M_1 - M_2}{\sqrt{\left(\frac{N_1 1^2 + N_2 2^2}{N_1 + N_2 - 2}\right)\left(\frac{N_1 + N_2}{N_1 N_2}\right)}}$$

An established table with values for "t" at the 5% and 1% levels was used to determine the level of significance.

By inspection of TABLE XV (which includes "t" ratio) it is evident that there is a significant relationship at the 5% level between TMF scores and High School Rank; therefore, the null hypothesis was rejected.

Hypothesis 22, as written in Chapter I, states:

> The scores on the CTMM for freshmen high school female students have no significant relationship to high school rank as measured by each student's standing as a graduating high school senior.

The same procedure to determine whether there was a significant relationship between TMF scores and High School Rank was applied to the female students graduating from South Dakota high schools.

Following is TABLE XVI (including "t" ratios) which gives a visual relationship between the TMF scores and rank in class.

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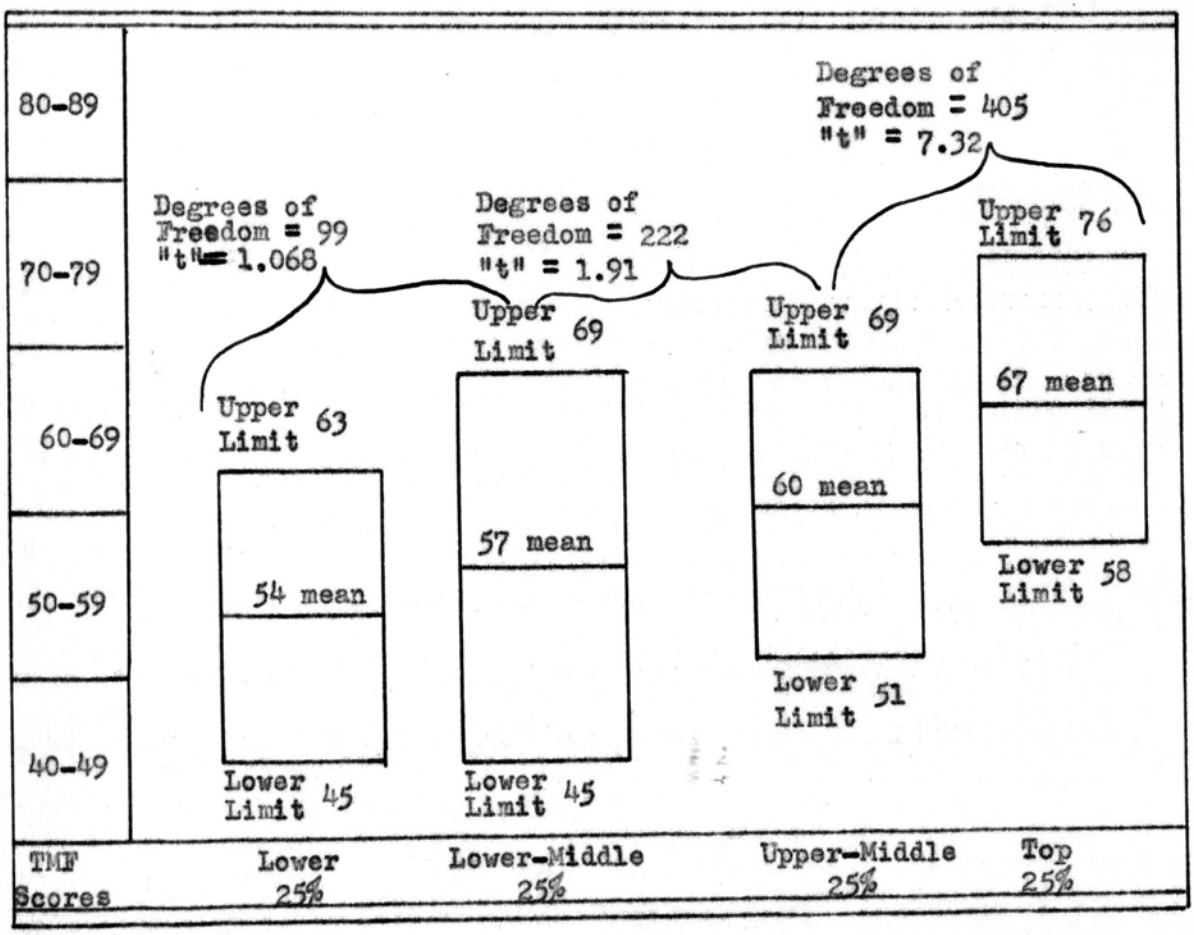
[19] E. R. Lindquist, A First Course in Statistics, p. 138, Houghton-Mifflin Company, New York, 1942.

TABLE XVI. MEAN AND A TWO S. D. BELT-RANGE OF HIGH SCHOOL RANK AS RELATED TO TMF SCORES FOR FEMALES IN SOUTH DAKOTA HIGH SCHOOLS



An investigation of TABLE XVI indicates that there is a slight relationship for the lower and lower-middle groups and a positive relationship for the upper-middle and top groups; thus the null hypothesis can be rejected, on the basis of these findings.

According to data from the sample of 1078 high school students, in South Dakota, TABLE XVII was developed. The purpose of the table was to aid in the prediction of a student's chances of being in the upper one-half of his high school graduating class. The prediction

was based on the range wherein the student's TMF score falls, as illustrated in TABLE XVII which follows:

TABLE XVII. TMF SCORES RELATED TO HIGH SCHOOL RANK
(BASED ON CHANCES PER 100)

TMF Scores	Upper 50% of Class
30-39	0
40-49	4
50-59	18
60-69	44
70-79	65
80-89	72
90-100	73

It is possible to predict the chances a student has of ranking in the upper 50% of the graduating class by substituting the TMF score into TABLE XVII. Assume that a student's TMF score is 55; he then would have approximately 18 chances in 100 of ranking in the upper one-half of the class; whereas if the score of the TMF was 75 there would be 65 chances in 100 of ranking in the top half of the class.

As this chapter is concluded there are certain facts in evidence which merit comment.

The average TMF score of males in the upper 25% of the high school graduating classes is significantly higher than the mean TMF

score for females in this same statistical category. Again, this indicates the fact, brought out in the review of literature, that females, with less ability, achieve better than males. This observation is true as evidenced in all quartiles of rank.

The study of high school rank for females as found in TABLE XVI indicates that there is little difference in the three lower quartiles. Apparently other factors influence high school rank for females. Some of these "other factors" could be social pressure for better achievement, physical attractiveness, and/or more tractable than males in the learning situations.

The fact that the top one-half of high school classes show a higher per cent of females may also be attributed to the fact that social pressures will often produce an anti-achievement attitude in males at the high school level.

It is possible to predict the high school rank more accurately for males than for females as indicated on the TMF scores which were based on the norms developed from actual achievement by the sample 1078 high school students in the 1957 graduating class from South Dakota schools.

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of Chapter V is to present conclusions developed from findings produced by this study.

A study of this type was undertaken because it was felt that it would be of value in providing norms by which educators, dealing with South Dakota high school students, could better interpret the value of scores obtained on CTMM and thereby make better use of the test as a predictive tool.

At the onset of the investigation, the 1957 graduating class of South Dakota high schools was selected as the sample; required data was secured and tabulated for use in statistical analyses and prediction measures.

Specific purposes, as carried out for this study, were to:

1. Determine the relationship of scores on the CTMM and G. P. A. earned in college.
2. Establish the relationship of TMF scores from the CTMM to High School Rank.

In regard to the first of these purposes, the following conclusions may be drawn:

1. The correlation coefficient of TMF scores on the CTMM and G. P. A. is significant in predicting college G. P. A.

2. The L scores from CTMM are valuable as predictive tools, but are not as consistent as TMF scores.

3. There is comparatively little value in the ML score as

far as prediction usage is concerned.

4. Little difference is apparent between scores received by Engineers at the School of Mines and those received by Engineers at South Dakota State College; the average TMF of Engineers at both School of Mines and SDSC tend to be higher than scores obtained by students enrolled in various curricula of the other colleges in the sample.

5. The average TMF scores, of females enrolled as students at the University of South Dakota and at SDSC, are very close; TMF scores obtained by females enrolled at all other South Dakota Colleges are lower than those of the USD and SDSC coeds.

6. Students in the Teacher Colleges have the lowest average TMF scores of all college students investigated.

7. Average first quarter grades are lower than the average grades indicated at the end of the first year. This is true in nearly all cases of the sample.

8. It is possible to predict, with greater accuracy, the first year grade than it is to predict first quarter grades in college. (This observation is based on a smaller standard error of estimate.)

With reference to the second purpose of this study, that of establishing the relationship of TMF scores from the CTMM to High School Rank, the following conclusions may be drawn:

1. The average TMF scores of male students ranking in the upper one-half of their high school class are higher than the average

TMF score received by females in the same category. (This upper one-half of the high school classes has a higher female population since it has been found that females, with less ability, achieve better than do males.

2. The prediction of High School Rank is possible through the use of the TMF scores as the predictive instrument.

Research still leaves a great number of unanswered questions concerning prediction, and regardless of how good predictions are they will never be perfectly accurate. Any improvement made in accuracy of prediction over "guessing" would be worthwhile; therefore, it is the hope of the writer that the findings produced by this study may be of some help in predicting college competence for South Dakota high school students.

Suggestions for Further Study

In this study there are many inadequacies in the findings, and in future studies of this nature the writer feels that the following suggestions could bring about improvements in the results of any like research.

The suggestions are as follows: 1. If is difficult to accurately assess the relationship of CTMM scores and high school rank based on four quartiles. To further divide the high school rank (as is done in Minnesota high schools where every student is ranked from the top to the bottom) seems in order. 2. Perhaps a division between Church Colleges and church-supported Junior Colleges should be included because of the difference in educational level. 3. A division in curricula and G. P. A. in the various colleges could be made. (For example: a division between trade school students and students enrolled in regular curricula at SSTC.)

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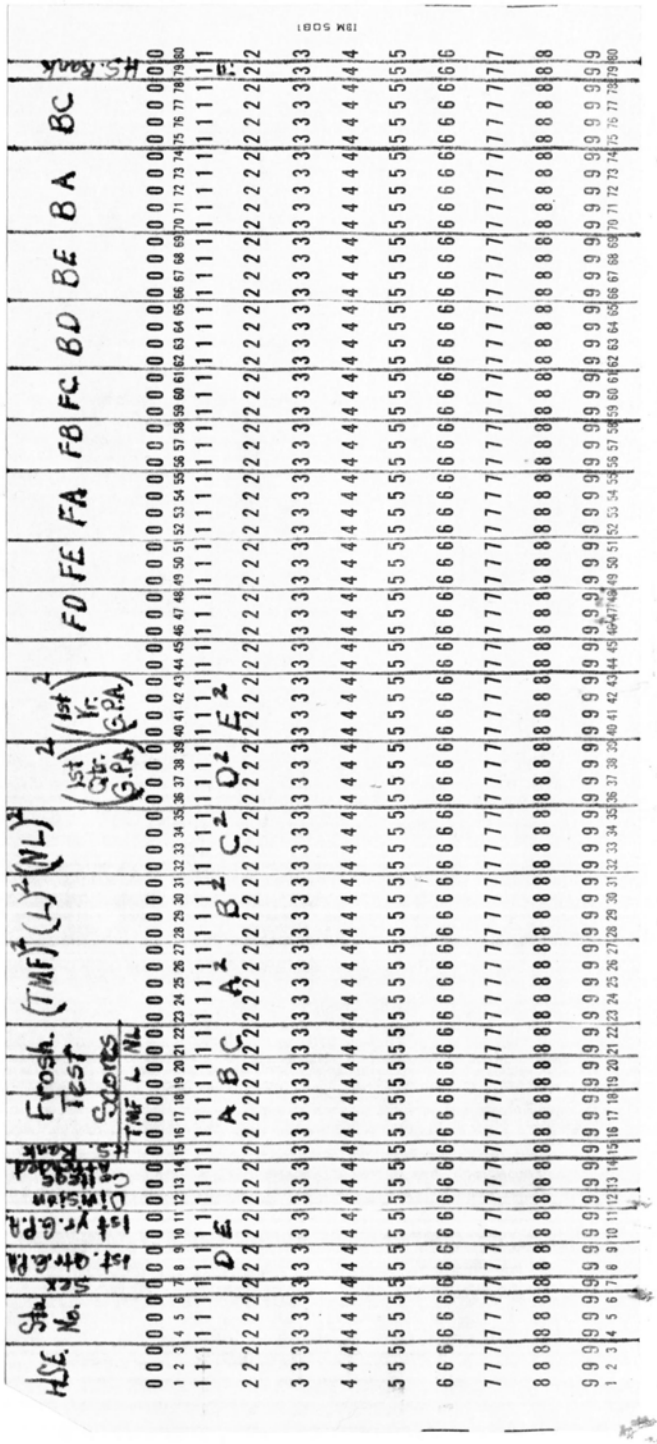
APPENDIXES

APPENDIX A

IBM SOURCE CARD



APPENDIX C

(COPY)

July 21, 1958

(Name)
(Name of School)
(City and State)

(Salutation)

At the College Public Relations meeting in Huron on July 15, you indicated that your college would cooperate in a research project of interest to the SDCPRA and to the South Dakota Guidance and Personnel Association. This project involves following up the high school graduates of 1957 to determine what happened to them in college. Another phase of this project involves the evaluation of the 1953-54 ninth grade testing program for these same students as it relates to their success in college.

On a separate sheet is outlined the data which we need for this study. The students which we are concerned about are only those who entered your college this fall and graduated from a South Dakota high school in the spring of 1957. Included in this study should be the names of students who started college but who did not complete a quarter or a semester.

We would like to have all of the data listed on the attached page. If however, your Records Office is somewhat resistant to providing all of the data, the essential data is the name, high school, and grade point average.

If there are any questions, please be sure and let me know as soon as possible.

Sincerely yours,

Gerald M. Fort
Associate Professor

GMF/gig