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An Analysis of Classification Tests at Western Kentucky State College

Hal Gilmore
Western Kentucky University

Gilmore,

Hal M.

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AN ANALYSIS OF CLASSIFICATION TESTS AT WESTERN KENTUCKY STATE COLLEGE

BY

HAL M. GILMORE

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Lee Francis Jones.

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TABLE OF CONTENTS

TABLES

CHAPTER I

INTRODUCTION

The problem of the selection and guidance of students for successful college work has long been a point of attack and interest for school administrators and teachers. Almost every accredited institution of higher learning now administers some battery of entrance tests.[1]

Although many studies have been made of the relation between test scores and achievement, very few significant correlations have been reported. There are at least two explanations for this. First, the absence of more significant correlations may reside in the unreliability and resulting invalidity of achievement ratings. The second reason for lack of higher coefficients resides in the real lack of correlation due to the great variety of abilities involved. Achievement records, even though reliable and valid, might not be expected to be accurately predicted from test scores which are measures of abilities not identifiable with the kind of achievement predicted. Prediction tests intended for prediction alone should be of the same type and in the same field as the achievement which is being predicted.[2]

The real value of the entrance tests—AMERICAN COUNCIL PSYCHOLOGICAL EXAMINATION FOR COLLEGE FRESHMEN, 1947 Edition, and the STANFORD ACHIEVEMENT TEST, Advanced Arithmetic, Form Dm—adminis-

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[1] Archer W. Hurd, "The Problem of the Prediction of College Success," The Journal of Educational Research, Vol. 38, No. 3 (November, 1944), p. 217.

[2] Ibid., p. 218.

tered at the Western Kentucky State College is unknown. The scores recorded on the arithmetic test may serve to determine whether or not a student will enroll for courses in mathematics, physics, and chemistry. Each of the three departments is provided with a list of those students whose scores on the arithmetic test place them in the lower half of their class. The department heads ordinarily advise these students to plan their programs in other departments, but if students persist in enrolling in courses in mathematics, physics, and chemistry, they are permitted to do so. The psychological test scores are recorded in the office of the Education Department of the institution on specially prepared filing cards and on the students' permanent record cards in the office of the Registrar. The main use made of these test results is individual guidance.

It is the purpose of this study to present the results of an investigation of these entrance tests, which were given under the auspices of the Registrar's Office and the Education Department to freshmen who entered school at Western Kentucky State College in September, 1948.

The present chapter will serve as a guide to the following chapters, and includes, in the order of appearance, these topics:

1. Statement of the problem
2. Scope of the study
3. Source of the data
4. Treatment of the data

Problem: The problem set up is of a three-fold nature, namely:

1. To determine the value, if any, of the entrance examinations as predictive agents for college success

2. To study the weaknesses exhibited by students on the arithmetic achievement test

3. To suggest remedial measures for the weaknesses revealed by the arithmetic test

Scope of the study: This study includes 500 freshmen who were administered entrance examinations, 465 of whom were given both the psychological test and the arithmetic test. First semester grades were available for 414 of these.

Source of the data: The data for this thesis were obtained from the students' permanent record cards on file in the Registrar's Office, from the psychological and arithmetic test scores recorded and on file in the Education Office, and from the arithmetic test score sheets themselves.

Treatment of the data: The data for this study are treated from a comparative, analytical, and statistical standpoint.

CHAPTER II

ENTRANCE EXAMINATIONS AND PREDICTION OF COLLEGE SUCCESS

The grade-point standings used in this study were computed at the end of the first semester on the basis of the ratings assigned grades by the College.

TABLE I
GRADE SYSTEM AND POINT RATING USED AT WESTERN KENTUCKY STATE COLLEGE

Grades	Point Rating
A	3
B	2
C	1
D	0
F	0

A pupil's standing is found by dividing his total point rating, or quality points, by the total number of hours he carried during the semester. For example, a student who received six semester hours of A's, three semester hours of B's, and six semester hours of C's (a total of thirty quality points) would have a grade-point standing of 2.0.

Two predictive devices were employed: The Pearson Product-Moment Technique for computing the coefficient of correlation and the Quadrant Scheme of Prediction.

The correlation between two test scores is customarily described as being high, marked or substantial, low or negligible.

Workers in the field of mental measurement generally agree that an r from

.00 to ±.20 denotes negligible relationship;
±.20 to ±.40 denotes low correlation; present but slight;
±.40 to ±.70 denotes substantial or marked relationship;
±.70 to ±1.00 denotes high to very high relation.[1]

TABLE II
CORRELATION BETWEEN VARIOUS PREDICTIVE CRITERIA

	r	P. E.	N
1	.656	.018	465
2	.467	.026	414
3	.447	.039	194
4	.433	.027	414
5	.432	.027	414
6	.367	.040	211
7	.302	.091	45
8	.058	.078	74

Number 1 represents the correlation between the A. C. E. and the Stanford Arithmetic Test;
Number 2 the correlation between the A. C. E. and the first semester point standings;
Number 3 between a combination of the scores of students in the highest and lowest 25 per cent on the A. C. E. and the first semester point standings;
Number 4 between a combination of the A. C. E. and Stanford Arithmetic Test and the first semester point standings;
Number 5 between the Stanford Arithmetic Test and the first semester point standings;
Number 6 between the Stanford Arithmetic Test and the combination point standings in mathematics, physics, and chemistry;
Number 7 between the scores of students in the lowest 25 per cent on the Stanford Arithmetic Test and the first semester point standings;
Number 8 between the scores of students in the lowest 25 per cent on the A. C. E. and the first semester point standings.

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[1] Henry E. Garrett, Statistics in Psychology and Education (New York, Longmans, Green & Co., 1940), p. 342.

It is noted that the coefficient of correlation existing between the two matriculation examinations is .656. According to the data listed above this would be classified as a substantial or marked relationship. However, in interpreting any coefficient of correlation the nature of the material dealt with must be considered.[2] In this case, a test of mental ability is being compared with an achievement test. The relationship between general intelligence and achievement in English and history usually runs from .40 to .60, and has to be above .70 to be considered high.[3] As students are more likely to have adequate backgrounds in English and history than in mathematics, the author has assumed, although no substantial evidence is available, that a correlation coefficient of .656 existing between a general intelligence test and an achievement test in arithmetic could be listed as "high." It is essential that mention be made of the fact that the correlation listed is a high one for group prediction, but would be of little significance for individual prognosis.

Upon examination of correlations 2 and 5 it is found that there is no significant difference in the coefficients between the scores on the psychological test and the semester grades and the arithmetic test scores and semester grades. A combination of the two test scores yielded a correlation of only .433, indicating no appreciable difference in the value of the three instruments as predictive agents.

The relatively low nature of these three correlations re-

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[2] Ibid., p. 343.

[3] Ibid.

stricts the use of the instruments used for predictive purposes. In order to predict a student's success in college with any degree of accuracy, it is necessary to look at the high school averages and all of the information that can be obtained on the student's background, personality, and physical well-being, as well as test scores in guiding students on the college level.[4]

It is not surprising, therefore, that the results reveal such low correlations. If the coefficients had been moderately or extremely high, there would be more cause for alarm than with the present results. Two criteria, neither of which is wholly reliable, are being compared: the point standings and the entrance tests as predictive devices.

As Guilford[5] says:

> "There is another factor working against fair tests of validity. This factor is indiscriminate pooling of marks from different subjects and from different instructors and treating them as if they were of the same coin. Any cursory inspection of grade distributions in a given institution of learning will show that marks are not by any means of constant value when obtained from different sources."

In an attempt to discover the best use which can be made of the psychological examination as a predictive agent, the author ran correlations between a combination of the scores of students in the highest and the lowest 25 per cent and the semester standings, and between the scores of students in the lowest 25 per cent, taken individually, and the semester standings. All things being

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[4] Mary A. Lanigan, "The Effectiveness of the Otis, the A. C. E., and the Minnesota Speed of Reading Tests for Predicting Success in College," The Journal of Educational Research, Vol. 41, No. 4 (December, 1947), p. 296.

[5] J. P. Guilford, Fundamental Statistics in Psychology and Education (New York, McGraw-Hill Book Company, Inc., 1942), p. 250.

equal, these coefficients should be rather high, since it is ordinarily assumed that those students who rank low on a general intelligence test will also rank low on their grade standings and those students who receive high scores on the intelligence test will likewise receive high grades. The correlations found were .447 and .058, respectively. It is seen from the results of the former that those students, taken as a group, whose scores on the psychological test placed them in either the highest or the lowest 25 per cent of the group taking the test received approximately the same grades as the class as a whole. The latter coefficient reveals that there is practically no relationship whatsoever between the scores of students in the lowest 25 per cent of their class on the psychological examination and their first semester standings.

Because of the arithmetical processes involved in the fields of mathematics, physics, and chemistry, it is safe to assume that students who have not mastered the fundamentals of arithmetic will encounter considerable difficulty in pursuance of such courses. One would expect, therefore, to find a high correlation existing between scores on the arithmetic test, especially the lowest 25 per cent, and the semester standings in the science area mentioned. However, a coefficient of .367 was found, one of the lowest reported. Here, again, a restriction is put on this instrument as a predictive device.

An analysis of the correlation between the scores of students in the lowest 25 per cent on the arithmetic test and the first semester standings reveals a coefficient of .302. There is no signif-

icant difference in the correlation reported for this group and that for the total number taking the test. In other words, those students, taken as a group, whose scores on the arithmetic test placed them in the lowest 25 per cent of their class received grades at the end of the first semester comparable to the class as a whole.

As these correlations cannot conveniently be used for predictive purposes, another method of showing the relationship of the measures with success in college was employed. The method consists in using the Quadrant Scheme[6] of comparing a measure with success in college. Table III illustrates the method.

The numbers along the top of Table III from left to right—0.69, 1.15, 1.97—represent, respectively, the lowest quartile, the median, and the highest quartile of the scholastic quotients. Thus, noting the four top squares, it is seen that nine scores ranked between 0 and 0.69, twenty between 0.69 and 1.15, thirty-six between 1.15 and 1.97, and thirty-four above 1.97. The other three columns are read in a similar manner.

Similarly, the numbers at the left of the table reading from bottom to top—76.36, 91.40, 111.43—represent, respectively, the lowest quartile, the median, and the highest quartile on the American Council Psychological Examination.

The frequency of scores for each small square is determined by a student's rank on the psychological examination as well as his first semester point standing. For example, it is noted that the

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[6] Sylvester B. Schmitz, "Predicting Success in College: A Study of Various Criteria," The Journal of Educational Psychology, Vol. 28, No. 6 (September, 1937), pp. [illegible].

TABLE III
QUARTILE SCORES AND POINT STANDINGS DISTRIBUTED BY QUADRANTS

Quartiles A. C. E.	Quartiles - Grade-Point Standing				Total
	0.69		1.15	1.97	
111.43	9	20	36	34	99
	II			I	
91.40	25	25	33	23	106
76.36	24	38	31	14	107
	III			IV	
	44	22	32	4	102
Total	102	105	132	75	414

number 34 appears in the top right-hand corner square. This means that thirty-four students recorded scores above 111.43 on the psychological test and had a point standing of 1.97 or better. In other words, their scores placed them in the highest quartiles of both their test scores and semester ratings.

The numbers in the right-hand column outside the large square represent the frequency of cases in each quartile of the psychological test. Thus, there was a total of ninety-nine scores above

111.43, one hundred six between 91.40 and 111.43, one hundred seven between 76.36 and 91.40, and one hundred two below 76.36. The numbers outside and below the large square--102, 105, 132, 75--in like manner, represent the total number of scores appearing in each of the quartiles of the first semester point ratings.

In Quadrant I it is noted that one hundred twenty-six students rated high or above average on both scholastic quotient and psychological scores. These students actually measure up to expectation with regard to their college work. As their scores on the psychological test were above average at the beginning of their college work, it is naturally expected that they will do better than average work in college. This is considered a normal group, but this quadrant contains only a part of the total normal group.

Quadrant III contains those students whose scores on the psychological test were below average and whose scholastic quotients at the same time were below average. Students with psychological scores below average will normally find college work more difficult, and thus it is normally expected that they will fall below the average in their college work. Quadrant III contains one hundred twenty-eight cases who, again, measure up to expectation. Quadrants I and III constitute the total normal group.

Quadrants II and IV contain those students whose college work does not coincide with expectancy. In Quadrant II there are seventy-nine cases in which the scores on the psychological test were above average but the college work was actually below average. Quadrant IV contains those students whose scores on the psychological test were below average, but who, by reason of exceptional

application and study, actually ranked above average in college work. Quadrant II, therefore, would contain those students who, on account of lack of application, sickness, or other factors, do not measure up to expectation. These two quadrants, therefore, will be considered the abnormal group.

Quadrant I	126
Quadrant III	128
Normal	254 - 61.3%
Quadrant II	79
Quadrant IV	81
Abnormal	160 - 38.7%

It is noted that two hundred fifty-four students, or 61 per cent, measure up to expectation as determined by the American Council Psychological Examination. In other words, this means that in sixty-one cases out of one hundred it is possible to predict approximately a student's subsequent success or failure in college. There are one hundred sixty cases, or 38 per cent, that do not fall in the normal group. Of these, seventy-nine, or 19 per cent of the entire group, have good intellectual ability but failed to apply themselves in college and thus rated below the average.

Forty-four out of one hundred two, or 46 per cent, of the students who ranked in the lowest quartile on the psychological test also rated in the lowest quartile in college work. In other words, it is possible to predict in forty-three cases out of one hundred (44 out of 102) the type of college work a student will do in college if it is known in advance that his score on the psychological

test is in the lowest 25 per cent of the group.

A student whose score on the psychological test is below 76.36 has only one chance in three (36 out of 102), approximately, of doing average college work or better. There is only one chance in twenty-five (4 out of 102) that a student in this group will appear in the highest quartile in college work. There are sixty-six chances in one hundred two, or about sixty-five in one hundred, that a student whose score on the psychological test is below 76.36 will not do average college work. By far the majority of the individuals rating low on the psychological test have very little hope for success in college. There are thirty-four chances in ninety-nine, or almost thirty-four in one hundred, that a student ranking in the highest quartile on the psychological test will likewise rate in the highest quartile in college work. A student in this group has seventy chances in ninety-nine of getting better than average rating on his college work. However, there are nine chances in ninety-nine, or one in eleven, that his scholastic rating will be in the lowest quartile, and twenty-nine chances in ninety-nine, or twenty-nine in almost one hundred, that his rating will be below the average.

It was hoped that the quadrant scheme of prediction would give a clearer picture of the measures used as predictive devices. However, as its use is of little significance, no further application of the technique was made in this investigation.

The data presented indicate that it would not be safe on the part of the administrator to use only one instrument for predicting success in college. In this study, many cases were found in the

group that did not measure up to expectation. As one instrument serves as a check on the others, it is advised that several criteria for predicting success in college be employed.

CHAPTER III

AN ANALYSIS OF THE ARITHMETIC TESTS

An analysis of the arithmetic test score sheets was made to determine the weaknesses exhibited by students so that a program which would serve to remedy the defects might be suggested.

The Stanford Arithmetic Test is divided into two parts: computation and reasoning. The errors made by the entrants were classified separately for the two tests. Tables IV and V give an analysis of these errors.

TABLE IV
AN ANALYSIS OF THE ERRORS MADE BY 500 FRESHMEN IN ARITHMETIC COMPUTATION

Question Number *	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
1	59	11.8	.237
2	47	9.4	.189
3	38	7.6	.153
4	47	9.4	.189
5	148	29.6	.594
6	45	9.0	.181
7	97	19.4	.389
8	168	33.6	.675
9	42	8.4	.169
10	99	19.8	.397
11	135	27.0	.542

*A copy of the Stanford Test is available in the appendix.

TABLE IV (Continued)

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
12	194	38.8	.779
13	122	24.4	.490
14	118	23.6	.474
15	101	20.2	.406
16	209	41.8	.839
17	106	21.2	.426
18	91	18.2	.365
19	184	36.8	.739
20	121	24.2	.486
21	151	30.2	.606
22	230	46.0	.923
23	59	11.8	.237
24	229	45.8	.919
25	176	35.2	.707
26	202	40.4	.811
27	218	43.6	.875
28	162	32.4	.650
29	42	8.4	.169
30	197	39.4	.791
31	149	29.8	.598
32	254	50.8	1.020
33	218	43.6	.875
34	59	11.8	.237

TABLE IV (Continued)

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
35	153	30.6	.614
36	71	14.2	.285
37	308	61.6	1.237
38	264	52.8	1.060
39	123	24.6	.494
40	121	24.2	.486
41	149	29.8	.598
42	399	79.8	1.602
43	129	25.8	.518
44	177	35.4	.711
45	198	39.6	.795
46	347	69.4	1.393
47	355	71.0	1.425
48	229	45.8	.919
49	352	70.4	1.413
50	342	68.4	1.373
51	323	64.6	1.297
52	295	59.0	1.184
53	371	74.2	1.490
54	369	73.8	1.482
55	332	66.4	1.333
56	320	64.0	1.285
57	315	63.0	1.265

TABLE IV (Continued)

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
58	434	86.8	1.742
59	347	69.4	1.393
60	343	68.6	1.377
61	361	72.2	1.449
62	395	79.0	1.586
63	445	89.0	1.787
64	474	94.8	1.903
65	436	87.2	1.751

TABLE V
AN ANALYSIS OF THE ERRORS MADE BY 500 FRESHMEN IN ARITHMETIC REASONING

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
1	64	12.8	.257
2	57	11.4	.229
3	51	10.2	.205
4	97	19.4	.289
5	82	16.4	.329
6	106	21.2	.426
7	149	29.8	.598
8	123	24.6	.494

TABLE V (Continued)

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
9	85	17.0	.341
10	193	38.6	.775
11	284	56.8	1.140
12	99	19.8	.397
13	254	50.8	1.020
14	110	22.0	.442
15	139	27.8	.558
16	114	22.8	.458
17	177	35.4	.711
18	161	32.2	.646
19	223	44.6	.895
20	310	62.0	1.245
21	180	36.0	.723
22	270	54.0	1.084
23	368	73.6	1.477
24	302	60.4	1.213
25	315	63.0	1.265
26	291	58.2	1.168
27	410	82.0	1.646
28	436	87.2	1.751
29	423	84.6	1.770
30	406	81.2	1.630
31	458	91.6	1.839

TABLE V (Continued)

Question Number	Number of Persons Missing	Percentage of Persons Missing	Percentage of Total Errors
32	460	92.0	1.847
33	477	95.4	1.915
34	482	96.4	1.935
35	486	97.2	1.951
36	491	98.2	1.971
37	494	98.8	1.983
38	494	98.8	1.983
39	495	99.0	1.987
40	497	99.4	1.995

The problems were classified into five groups: fundamental operations, percentage, fractions and decimals, measures, and miscellaneous. All exercises not applying to the first four categories were included in the "miscellaneous" group. Several exercises appeared in more than one of the five groups. For example, a problem involving the addition of fractions would appear under "fundamental operations" as well as under "fractions and decimals." There is no way of ascertaining whether an error made on a problem of this type was due to faulty addition, inability to handle fractions, or a combination of both. The number of problems applying to more than one classification is small enough to be considered negligible, however.

Table VI reveals the percentage of total errors made on both

parts of the test.

TABLE VI
PERCENTAGE OF TOTAL ERRORS OF 500 FRESHMEN ON THE STANFORD ARITHMETIC ACHIEVEMENT TEST

Abilities Measured	Per Cent of Total Errors
Fundamental Operations	15.3
Percentage	30.5
Fractions and Decimals	16.9
Measures	18.2
Miscellaneous	29.0

It is noted that fundamental operations were responsible for 15.3 per cent of the total errors; percentage, 30.5 per cent; fractions and decimals, 16.9 per cent; measures, 18.2 per cent, and miscellaneous, 29 per cent. As such information was not accessible to the author, a comparison of these data with similar studies was impossible. It is believed, however, that the results of this examination would differ but little from any reported by other institutions.

One becomes alarmed when these results are studied from a different point of view. A total of 52,500 problems—one hundred five problems per test—were included in the 500 administrations. Of this amount, 24,907 errors, a little over 47 per cent, were recorded, with the average number of errors per person amounting to 49.8.

It is evident that a need for improvement in the basic fundamentals of arithmetic exists. The big problem is how to meet this

need.

Research evidence shows that a systematic program of remedial instruction, in which teaching and practice are focused on a limited number of type skills, will bring about marked improvement within a comparatively short time.[1] Freshmen who do not possess the abilities needed in work involving arithmetic—namely the fields of mathematics, physics, and chemistry—should be provided with an instructional program whereby they may have opportunity to overcome their handicaps. The establishment of such a program would necessitate an analysis of the arithmetic skills necessary for success in the basic courses in the fields mentioned, in order that a concentrated course in arithmetic might be prepared for those students manifesting weaknesses on the achievement examination. Such a course should be pursued prior to enrollment in the introductory courses in mathematics, physics, and chemistry.

The following plan to determine who should enroll for the special arithmetic classes is suggested:

All students who rank below the 50th percentile on the Stanford Test would be classified as "possibilities" for the course. These students would be given another examination of comparable form to the original one. This would allow those entrants who made low scores because of any factors other than inability itself (illness at the time of the administration of the test, misunderstanding of directions, emotional disturbance, homesickness, etc.) to demonstrate

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[1] W. S. Guiler, "Difficulties Encountered in Percentage by College Freshmen," The Journal of Educational Research, Vol. 40, No. 2 (October, 1946), p. 95.

whether they were capable of ranking in the upper half of their class under ordinary conditions. Students whose scores placed them on or above the 50th percentile on the first test and students coming up to this standing upon the second administration would be exempt from the proposed remedial course.

All students in the lower group of the first test would be given the second form of the test regardless of their intention to enroll for classes in mathematics, physics, and chemistry. This would reduce the amount of time and labor necessary for conducting the testing program.

It is further suggested that the students ranking in the lower half of their class on both forms of the arithmetic test be required to attend the special help classes prior to undertaking work requiring a mastery of those skills for which they have shown decided deficiencies. Elective credit should be granted for such work.

The suggested courses could be taught by graduate students, or upper classmen, majoring or minoring in mathematics. Credit for practice teaching could be given for instruction of this type if it could be carried on under the auspices of the Training School. The classwork would be highly individualized, each pupil being notified of his weaknesses in order that he might concentrate his study on them. Standards of attainment would have to be set up by which a student would be able to terminate his attendance of such classes after having successfully overcome his defects.

It is the opinion of the author that such a plan of remedial work would greatly reduce the amount of failure in the fields of mathematics, physics, and chemistry, as well as reduce the number

of freshmen who withdraw from school each semester because of poor showing in their course work as a result of inadequate backgrounds in the fundamentals of arithmetic. As the work in arithmetic should function in their ordinary life activities, it is also probable that such remedial work would be of value to students even though they do not enter courses in mathematics, physics, and chemistry. At any rate, such instruction would be of more value than a failure in a more advanced course in any of the fields mentioned.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study gives the comparative value of several criteria for predicting success in college. The scholastic success of pupils, stated in terms of grade-point standings, was compared with their test scores on (1) the American Council Psychological Examination, (2) the Stanford Arithmetic Achievement Test, (3) a combination of these two tests, (4) the scores of students in the highest and lowest 25 per cent of their class on the psychological examination, (5) the scores of students in the lowest 25 per cent of their class on the arithmetic test, and (6) the scores of students in the lowest 25 per cent of their class on the psychological examination. Correlations were computed between the two entrance examinations and between the arithmetic test scores and standings in mathematics, physics, and chemistry.

Two techniques for determining the value of the instruments were employed: the coefficient of correlation and the quadrant scheme of prediction. The quadrant scheme was not utilized to any further extent because its value was, in general, equal to that of the coefficient of correlation, and no clearer perspective could be gained by its use.

The psychological examination appears to be the best predictive agent for college success, while the scores of students in the lowest 25 per cent on the arithmetic test are of least value. An examination of the coefficient of correlation found between the predictive element and freshman marks in the specific subject matter fields indicates that differential prediction is more restricted than

is prediction for general scholarship.

It is not difficult to explain the low nature of the correlations reported between grade scores and the test instruments. Personality factors, perseverance, interest characteristics, physical well-being, and study habits, which are not measured, may operate to determine a higher or lower course grade than would be anticipated solely on the basis of intelligence or achievement ratings. A low correlation might result, too, when the reliability of the marking system is not high because of lack of objective measurement.

The analysis of the arithmetic test score sheets reveals that, with the exception of the "miscellaneous" group consisting of a variety of exercises, problems in percentage and measures offered the most difficulty to the entrants.

It is the conclusion of the author that the discrepancies in standards and lack of uniformity in the grading system employed in this institution make it difficult to predict a student's success in college by the scores made on the entrance examinations.

The following recommendations are made by the author:

1. In view of the relatively low correlations between the predictive agents and success in college, as measured by students' marks, it is probable that considerable attention should be given to the problem of getting greater consistency in the grading system. It is recommended that a study of the system currently in use be made with the end in view that a greater degree of reliability might be attained. This procedure would involve securing uniform standards, a prime necessity for success in a guidance program.

2. It would be well to initiate some form of study-help classes

by means of which students needing aid in the fundamentals of arithmetic would have a chance to overcome their deficiencies. In order to organize for this remedial work, the College might find it desirable to classify students on the basis of the results of a testing program with the end that they might be given a semester's or a year's program of remedial work upon the level of their competence. In the various departments, particularly the science departments, it might be desirable that the departments themselves handle the remedial work to overcome the defects.

3. The relatively low nature of the coefficient of correlation existing between the scores of students on the arithmetic test and success in mathematics, physics, and chemistry may indicate that the poor work done in these fields is a result of an inability to understand the reading matter found in many of the problems. It might be helpful, therefore, to provide remedial work in reading for study purposes.

It is the conviction of the author that similar investigations would prove advantageous to college students.

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APPENDIX

STANFORD ACHIEVEMENT TEST

By TRUMAN L. KELLEY, GILES M. RUCH, and LEWIS M. TERMAN

ADVANCED ARITHMETIC TESTS
FORM DM

For Use with Separate Answer Sheet

Do not open this booklet or turn it over until you are told to do so.

Samples

1 Add

$$\begin{array}{r} 3 \\ 2 \\ \hline \end{array}$$

2 Subtract

$$\begin{array}{r} 4 \\ 1 \\ \hline \end{array}$$

3 Multiply

$$\begin{array}{r} 4 \\ 2 \\ \hline \end{array}$$

Answers

1 *a* 1 *b* 7 *c* 10 *d* 5 *e* not given

2 *f* 2 *g* 5 *h* 3 *i* 4 *j* not given

3 *a* 6 *b* 2 *c* 10 *d* 7 *e* not given

4 How many eggs are 3 eggs and 1 egg?

4 *a* 3 *b* 4 *c* 6 *d* 5 *e* not given

5 Joe had 5 cents. He spent 4 cents. How many cents did he have left?

5 *f* 9 *g* 4 *h* 1 *i* 3 *j* not given

Published 1941 by World Book Company, Yonkers-on-Hudson, New York, and Chicago, Illinois

PRINTED IN U.S.A.

DIRECTIONS. Find the right answer to each example among the five answers shown at the right. Make a mark on your answer sheet in the space that has the same letter as your choice. Look carefully at each example to see what it tells you to do. Do your figuring on a separate sheet of paper.

1 Multiply
398
400

2 $34\overline{)1428}$

3 Add
731092
543127
860573

4 Subtract
10
$9\frac{1}{3}$

5 Subtract
937146
419087

6 Add
$\frac{1}{8}$
$\frac{3}{5}$

7 Multiply
1.825
100

8 $\frac{4}{5} \times \frac{3}{10} =$

9 $\frac{1}{5} =$ ____%

10 Subtract
$\frac{5}{6}$
$\frac{1}{3}$

11 Multiply
.028
.16

12 .02 = ____%

13 Subtract
4387.4832
941.6135

14 Multiply
457
260

15 30% of $16.00 =

16 9% = $\frac{}{100}$

17 $\frac{8}{10} =$ ____%

18 Find the average
18 bu.
23 bu.
12 bu.
3 bu.

19 $\frac{1}{4} \div 3 =$

20 Add
8.750
46.982
274.909
800.314
745.805

21 Add
$8\frac{1}{4}$
$11\frac{5}{6}$
$20\frac{3}{4}$

Answers

1 *a* 1592 *b* 15920 *c* 169200 *d* 159200 *e* not given

2 *f* 41 *g* 68 *h* 48 *i* 44 *j* not given

3 *a* 2134792 *b* 1134792 *c* 2134782 *d* 2034792 *e* not given

4 *f* $1\frac{2}{3}$ *g* $\frac{2}{3}$ *h* $1\frac{1}{3}$ *i* $19\frac{1}{3}$ *j* not given

5 *a* 517059 *b* 528059 *c* 418059 *d* 518059 *e* not given

6 *f* $\frac{3}{8}$ *g* $\frac{1}{2}$ *h* $\frac{1}{4}$ *i* $\frac{3}{16}$ *j* not given

7 *a* 1825.0 *b* .001825 *c* 182.5 *d* 18.25 *e* not given

8 *f* $2\frac{2}{3}$ *g* $4\frac{1}{6}$ *h* $1\frac{1}{10}$ *i* $\frac{6}{25}$ *j* not given

9 *a* 1 *b* 5 *c* 20 *d* $\frac{1}{5}$ *e* not given

10 *f* $\frac{1}{3}$ *g* $\frac{1}{2}$ *h* $1\frac{1}{6}$ *i* $\frac{1}{12}$ *j* not given

11 *a* .0448 *b* .00448 *c* .00348 *d* .00488 *e* not given

12 *f* 50 *g* 20 *h* 2 *i* $\frac{1}{2}$ *j* not given

13 *a* 34458.697 *b* 3445.7697 *c* 3446.8697 *d* 3445.8697 *e* not given

14 *f* 11882 *g* 118820 *h* 119820 *i* 108820 *j* not given

15 *a* $480 *b* $.48 *c* $4.80 *d* $5.33 *e* not given

16 *f* 91 *g* 90 *h* $11\frac{1}{9}$ *i* 9 *j* not given

17 *a* 8 *b* 80 *c* 40 *d* $87\frac{1}{2}$ *e* not given

18 *f* 55 bu. *g* 14 bu. *h* $14\frac{1}{4}$ bu. *i* $16\frac{1}{2}$ bu. *j* not given

19 *a* $\frac{1}{12}$ *b* $\frac{3}{4}$ *c* 12 *d* $\frac{1}{6}$ *e* not given

20 *f* 1876760 *g* 1876.860 *h* 1876.760 *i* 1875.760 *j* not given

21 *a* $40\frac{5}{}$ *b* $39\frac{5}{}$

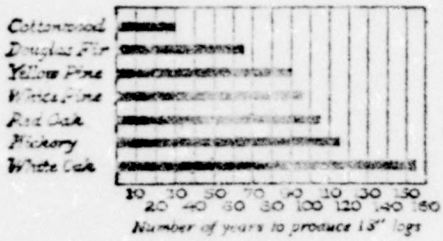

FIG. 1

43 What tree takes 3 times as long to produce 18-inch saw logs as the cottonwood, according to Figure 1?

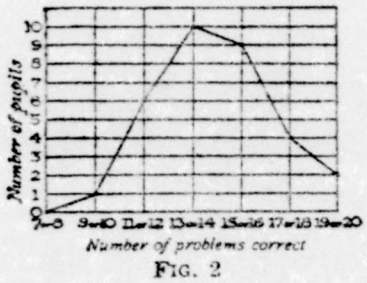

FIG. 2

44 How many more pupils had 15 or 16 problems correct than those who had 11 or 12 problems correct, according to Figure 2?

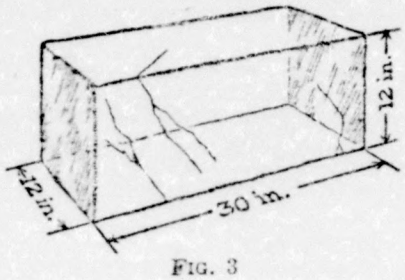

FIG. 3

45 How many cubic inches of ice are there in the piece of ice shown in Figure 3?

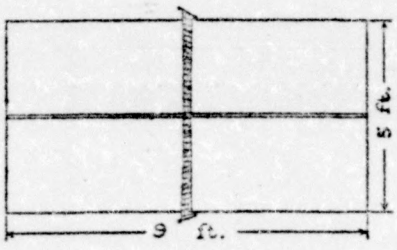

FIG. 4

46 What is the area of the ping-pong table in Figure 4 in *square yards*?

47 List price = \$200
Discounts = 10%; 2%
Net price = \$_____

48 $3x - 10 = 20$
$x =$

49 25 = ____% of 5.

50 \$25 = 12½% of \$____

51 4 : 5 = 8 : ____

52 Add
+16
−24

53 If 15% of a number is \$60, what is the number?

54 $\frac{+28}{-4} =$

55 $\frac{y}{2} = 80$
$y =$

Answers

43 *a* Douglas fir *b* yellow pine *c* white oak *d* hickory *e* not gi

44 *f* 9 *g* 3 *h* 4 *i* 2 *j* not gi

45 *a* 360 *b* 432 *c* 4320 *d* 1044 *e* not gi

4

46 *f* 5 *g* 15 *h* 45 *i* 3 *j* not gi

47 *a* \$176.40 *b* \$24.00 *c* \$176.00 *d* \$20.00 *e* not gi

48 *f* 30 *g* 2 *h* 10 *i* $3\frac{1}{3}$ *j* not gi

49 *a* 5 *b* 20 *c* 50 *d* $\frac{1}{5}$ *e* not gi

50 *f* \$200 *g* \$3.13 *h* \$625 *i* \$100 *j* not gi

51 *a* $2\frac{1}{2}$ *b* 16 *c* 10 *d* 8 *e* not gi

52 *f* −8 *g* 40 *h* 8 *i* −40 *j* not gi

53 *a* \$900 *b* \$400 *c* \$360 *d* \$40 *e* not gi

54 *f* 7 *g* 24 *h* 32 *i* −7 *j* not gi

55 *a* 40 *b* 78 *c* 160 *d* 164 *e* not gi

Go right on to Example 56 on the next page.

DIRECTIONS. Find the answers to these problems as quickly as you can. Note the letter of the right answer and mark the space under this letter on the answer sheet.

	Answers
1 Eight oranges are what fraction of a dozen, in simplest form?	1 *a* $\frac{3}{4}$ *b* $\frac{2}{3}$ *c* $\frac{1}{8}$ *d* $\frac{1}{2}$ *e* not g
2 Mrs. Rose needed 8 pieces of cloth, each $3\frac{1}{4}$ yd. long, for curtains. How many yards of cloth did she need in all?	2 *f* 26 *g* 28 *h* 25 *i* 13 *j* not g
3 The clerk of Morris County is paid \$4800 a year. What is his salary per month?	3 *a* \$40 *b* \$440 *c* \$12 *d* \$4 *e* not g
4 A delivery boy made 8 stops the first half hour. At that rate how many stops will he make in $2\frac{1}{2}$ hours?	4 *f* 36 *g* 24 *h* 32 *i* 40 *j* not g
5 How many cubic feet of earth must be removed in digging a cellar $10' \times 20' \times 30'$?	5 *a* 3600 *b* 6000 *c* 600 *d* 60000 *e* not g
6 Mr. Emory sold \$5000 worth of goods, receiving a commission of $2\frac{1}{2}\%$. What was his commission?	6 *f* \$12500 *g* \$12.50 *h* \$2000 *i* \$125 *j* not g
7 Paul feeds his chickens $\frac{3}{8}$ pk. of grain at each feeding. He has $3\frac{3}{4}$ pk. of grain left. How many feedings has he left?	7 *a* $3\frac{3}{8}$ *b* 6 *c* 10 *d* 4 *e* not g
8 The scale on a drawing reads $1'' = 10'$. What actual distance is represented by a line $3\frac{1}{2}$ inches long?	8 *f* $30\frac{1}{2}$ ft. *g* 45 ft. *h* 35 ft. *i* 35 in. *j* not g
9 The distances a motorist drove during each hour of a 7-hour trip were: 43 mi., 37 mi., 34 mi., 41 mi., 42 mi., 35 mi., and 41 mi. How many miles an hour did he average?	9 *a* 39 *b* 283 *c* 273 *d* 40 *e* not g
10 The diameter of a circular fountain is 56 feet. What is the circumference? (Use $3\frac{1}{7}$ for π.)	10 *f* 176 ft. *g* 112 ft. *h* 196 ft. *i* 88 ft. *j* not g
11 Dave had saved \$5.45. He and his three brothers earned \$3.00 more, which they shared equally. How much did Dave have then?	11 *a* \$6.45 *b* \$2.45 *c* \$8.45 *d* \$6.20 *e* not g
12 80 acres, or $\frac{1}{8}$, of Mr. Hart's farm is pasture. How many acres are there in his farm?	12 *f* 10 *g* 560 *h* 640 *i* 80 *j* not g
13 The Evans family started on an 800-mile trip. They drove 200 miles the first day. What per cent of the total distance did they drive the first day?	13 *a* $\frac{1}{4}$ *b* 4 *c* 25 *d* 400 *e* not g

Go right on to Problem 14.

		Answers			
27 A city block is 180 ft. by 200 ft. What is its area in *square yards*?	27	*a* 4000	*b* 36000		
		c 760	*d* 3600	*e* not g	
28 Mrs. Ray borrowed $1500 at 4% interest for 3 months. What was the total principal and interest that she had to pay?	28	*f* $15.00	*g* $60.00		
		h $1560.00	*i* $1515.00	*j* not g	
29 The ratio of the populations of two cities is 9 to 12. What is this ratio in decimal form?	29	*a* 1.33	*b* .75		
		c 9.12	*d* .108	*e* not g	
30 Angle *A* of triangle *ABC* is 45° and angle *B* is 60°. How many degrees are there in angle *C*?	30	*f* 75	*g* 15		
		h 255	*i* 95	*j* not g	
31 Mary found that the shadow of the schoolhouse was 60 ft. long at the time her own shadow was 4 ft. long. Mary is 5 ft. tall. How tall is the schoolhouse?	31	*a* 75 ft.	*b* 59 ft.		
		c 70 ft.	*d* 48 ft.	*e* not g	
32 Tom divided 16 by 33. What answer should he have found, *correct to the nearest hundredth*?	32	*f* 2.06	*g* .05		
		h .48	*i* .49	*j* not g	
33 A farm has 40 acres, or .125 of the total farm, under water. How many acres are there in the farm?	33	*a* 5000	*b* 320		
		c 5	*d* 32	*e* not g	
34 Mr. Jones paid $1125 for a bond of $1000 face value. How much interest should he receive each year if the rate is 5%?	34	*f* $50.00	*g* $56.25		
		h $16.25	*i* $125.00	*j* not g	
35 A house valued at $10,000 was insured against fire for 80% of its value. The rate was $.20 per $100. How much was the premium for one year?	35	*a* $20	*b* $184		
		c $160	*d* $16	*e* not g	
36 How many degrees of a circle graph should be used to show the fact that 55% of the people of a county live in cities?	36	*f* 55	*g* 138		
		h 198	*i* 92	*j* not g	
37 An invoice was marked "2%, 30 days; 60 days, net." The invoice amounted to $2500. What was the cost if paid immediately?	37	*a* $2400	*b* $2450		
		c $2500	*d* $2550	*e* not g	
38 Triangles *RST* and *R'S'T'* are similar. Side *RS* is 24′, side *ST* is 12′, and side *R'S'* is 6′. How long is side *S'T'*?	38	*f* 24′	*g* 36′		
		h 3′	*i* 30′	*j* not g	
39 Mr. Ray bought 1600 sq. ft. of sod. If he sods a square piece of ground, how many feet long will each side be?	39	*a* 400	*b* 4000		
		c 4800	*d* 40	*e* not g	
40 What does $500 amount to in 2 years at 6% interest, compounded annually?	40	*f* $61.60	*g* $560.00		
		h $561.80	*i* $512.00	*j* not g	

End of Test 2. Look over your work.