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Significance of selected measures with relation to freshman-accounting achievement

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SIGNIFICANCE OF SELECTED MEASURES WITH RELATION TO FRESHMAN-ACCOUNTING ACHIEVEMENT.

BOSTON UNIVERSITY

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THESIS

SIGNIFICANCE OF SELECTED MEASURES WITH RELATION TO FRESHMAN-ACCOUNTING ACHIEVEMENT

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CHAPTER I

STATEMENT OF THE PROBLEM

I. THE PROBLEM

The purpose of the study was to determine the value of selected measures in predicting achievement in freshman accounting at the Boston University College of Business Administration.

Specifically, the study employed:

1. A series of guidance tests

2. Accounting grades of the first and second semesters

3. Indication of bookkeeping or no prior bookkeeping status prior to college entrance.

And, specifically, the study undertook investigation of:

1. The statistical characteristics of the sample

2. The correlation findings between the guidance variables and the criteria

3. The significance of the differences in the means of the variables between the high and low achievers

4. The possibility of high correlation coefficients with which to portray best possible estimates of the second-semester grades through regression equations.

II. JUSTIFICATION OF THE STUDY

Inasmuch as every student at Boston University College Business Administration is required to take the year's course in freshman accounting, A1-2 and A3-4, a study of academic achievement in the course was considered important to the

welfare of a large portion of the student body. Only students who passed A1-2 were permitted to take A3-4; those who failed the first semester repeated the subject during the second semester. The course being most advanced in A3-4, the key point of the following study was with students in that group, where the requirements for the first-year achievement was at the maximum.

III. TEST SCORES AND ACADEMIC PREDICTION

Definite recognition has been given to the use of tests in The Use of Tests in College (9:10), the compilation of which Darley was chairman. An extract purports the stand taken, "It can be maintained that tests properly used in conjunction with all the other available evidence, do frequently give information of value in forming a judgment or reaching a decision and give it in an economical way."

The legitimacy of test interpretation when used guardedly proceeded from Beardsley's (4:529-530) description of the ideal vocational counselor:

> He is well versed in the values and limitations of psychological tests...He is fully aware that test results are much less reliable for purposes of individual counseling than for selecting a group of individuals as a whole. This basic distinction is important to him because most of the published research on tests is concerned with group comparisons. He is realistic in interpreting test results for individual guidance only by clearly distinguishing the nature of his problem from conclusions reported in the framework of individual group differentiations. The low reliability of prediction will be surprising (as indicated by the Error of Estimate of Regression Equations). The net result is that his psychological study of the individual's

capacities is at least partly clinical instead of purely mechanistic. Present limitations in the development of tests are such that he knows from experience that he is reduced to judgment in the final analysis. The essential contribution of tests is to provide part of the information upon which his judgment is based...

He uses qualitative analysis of test results. His diagnostic efforts transcend simple consideration of test scores. He considers also the possibilities of improvement in the functions measured, on the part of his client. He knows that when certain factors exert the greater influence on test performance there is more latitude for improvement than when other factors exert the greater influence.

As has already been noted, the role of test scores is that of supplying data, one source of information, and that needs to be supplemented. An Editorial (7:539-541) in the guidance magazine Occupations reminded us that:

Success in vocation, as in other undertakings of practical life, is a product of many factors. Among them are: degree of intelligence, health and physical status, economic circumstances of the family, social environment, emotional stability, moral and volitional factors..., specialized skill and knowledge...circumstances arise which could not possibly have been foreseen or planned and which create a veritable revolution in their vocational lives...

The psychologist also knows that his instruments are geared to measure present ability and present interests. By adding high school marks to test scores,...applicants whose test scores and previous marks fall below a certain point are not likely to make good grades in college. But at best he should speak only in terms of group probability. He cannot foretell the fate of any individual...

There are several remedies that vocational psychologists can apply in ridding themselves of the propensity to use terms connoting fortune telling:

1. When we have a correlation we can state it plainly and stop. Let us discard the cloak of soothsayer and acknowledge a simple correlation between two arrays of figures.

2. In titles of articles we can substitute the words guidance or selection.

3. The crucial factors that determine their vocational paths are most often occurrences such as these: (external events). Surely one who presumes to foretell a person's vocational future should also prophesy whether the individual will find a job in the occupation.

Traxler (22:1,3), Assistant Director for the American Institute of Accountants' current research experiment on selecting and guiding prospective accountants, reminded us that college grades for similar standards may vary from an A in one college to a C in another.

The marking system, however, proved to be the college record of academic performance, the thermometer of achievement status. In accordance with the general practice of American colleges to use a marking system, the readily available source for estimating degree of success was employed as a criterion in the study.

IV. REVIEW OF RELATED RESEARCH

In 1943, Durflinger (10:68-78) investigated the correlations of many studies of relationship between college grades and intelligence results. He found them somewhat higher than the .40 to .50 median reported previously in the literature. The study found that multiple correlation coefficients were rarely higher than .80 regardless of the variables used, the middle r being between .60 and .70, and that the highest multiple r was usually brought about through the combination of a good intelligence test, an achievement test, and high school marks.

Quaid (19:353-363) remarked in his extensive thesis concerning 140 freshmen at Phillips University, Oklahoma in 1934-1935:

> About the only statement one can make with confidence about the comparative predictive efficiency of high school average marks, American Council Test Scores and the Ohio State Psychological Examination is that none is best for all levels of ability or for both sexes...the mental tests relatively overrating the boys and high school marks relatively overrating the girls. When combined, high school marks and mental tests tend to counteract each other and to yield more uniform results with the sexes.

Likewise, he found that the first-semester marks are still the best single prediction of second-semester marks. Then he continued:

> Most freshmen continue their first-semester courses without change of teachers and with little change in class personnel...Correlation of second-semester college marks with first-semester college marks (concerning general scholarship) is .784 with a probable error of +-.021 and a probable error of estimate of +-.219.
>
> Multiple correlation of second-semester marks with first-semester college marks, high school average marks and Ohio State University Psychological Examination scores and English Aptitude Test (Purdue Placement Test in English) is .836, with a probable error of estimate of +-.292.

Crawford and Burnham (8:133) illustrate the decreasing effect of group marking upon the correlation, as when the letter system is used. Referring to the Yale studies for the class of 1936, which used the numerical grades by fives, correlations between the first- and second-semester grades in the same courses ranged from .81 to .89, the median coefficient being .84. When the letter system of five grades A, B, C, D, F were used for the class of 1945, the reliability coefficients ranged

from .53 to .85 with a median coefficient of .73. Emphasis was placed on the suggestion of increasing the use of objective achievement tests to stabilize the criteria of scholastic progress and use "in conjunction with, and supplementary to, subjective judgments since both types of appraisal seem necessary to full, well-rounded evaluation."

McGehee (13:88-93), of North Carolina State College of Agriculture and Engineering, made a study of predicting differential achievement in a technological college. The tests used were the American Council Psychological Examination (1939), the Cooperative English Test (Form OM), and the Cooperative Mathematics Test (Form P). He found the following correlations, using 700 students in the school year of 1939-1940:

Curricula Point Average	N	A.C.E.	Eng.Test	Math.Test	All Tests
Agriculture	199	.34	.34	.27	.41
Engineering	383	.48	.46	.50	.57
Textile	72	.34	.39	.52	.55
Vocational Ed.	46	.45	.58	.53	.65
All Curricula	700	.44	.44	.43	.53

Attention was drawn to the fact that with the exception of the Mathematics Test, where textile surpassed engineering by a margin of .02, all of the tests and their combinations measured highest in the fields of vocational education and engineering.

The index of forecasting efficiency (E) for the coefficients of correlation between the point-average ratio and scores were given:

Curricula	A.C.E.	Eng.Test	Math.Test	All Tests
Agriculture	6.0	6.0	3.9	8.8
Engineering	12.3	11.2	13.4	17.8
Textile	6.0	7.9	14.6	16.5
Vocational Ed.	10.7	18.5	15.2	24.0
All Curricula	10.2	10.2	9.7	15.2

In the forecasting efficiency percentage, vocational education and engineering were again highest across the table with the exception of the Mathematics Test, where textile surpasses engineering by 1.2. On the basis of the tests revealing least value for forecasting in the field of agriculture, the suggestion was made for a job analysis of the requirements needed for academic success.

Success in advanced accounting courses at the Boston University College of Business Administration, as indicated by certain tests and combinations thereof used by the Department of Student Personnel, was undertaken by van Slyke (23:31-34) in 1947. Measures of central tendency and deviation, using the standard scores of ninety-three cases, were cited:

	M	$\bar{\sigma}$
Cal MM (Nonlang)	48.45	6.57
Cal MM (Lang)	48.62	10.00
Cal MM (Total)	49.22	9.66
N-D (Vocab)	48.90	9.91
N-D (Paragraph)	48.97	9.87
Mich vocab (Total)	48.60	9.84
Minn Voc (Numbers)	48.32	9.60
Minn Voc (Names)	48.87	9.90
Minn P. F. Bd.	48.65	9.81
Kuder (Computational)	48.84	9.63
Kuder (Clerical)	48.60	9.86
Arith (Reasoning) N 76	51.01	8.77
Mean Scores 2, 5, 6	48.34	8.58
Mean Scores 1, 7, 9	48.43	6.57
Grade Indices	48.68	9.38
Grade Indices	48.81	10.05

Using the Pearson product-moment technique for the simple correlations and a three-variable multiple correlation for the combination mean scores, the findings were:

	r	+-P.E.
Cal MM (Nonlang)	.173	.068
Cal MM (Lang)	.255	.065
Cal MM (Total)	.270	.065
N-D (Vocab)	.233	.066
N-D (Paragraph)	.360	.061
Mich Vocab (Total)	.243	.062
Minn Voc (Numbers)	.243	.066
Minn Voc (Names)	.296	.064
Minn P. F. Bd.	.137	.079
Kuder (Computational)	.303	.064
Kuder (Clerical)	.146	.069
Arith (Reasoning) N 76	.384	.066
Mean Scores 2, 5, 6	.347	.062
Mean Scores 1, 7, 9	.260	.065
13 and 14 (Multiple R)	.376	.060

The correlations were summarized as showing a low positive relationship with no predictive value and surveyed as follows:

> All of the correlations computed were positive and ranged from a low of +.137, using the Revised Minnesota Paper Form Board Test and a high of +.384, using the Arithmetic Reasoning Test, Form B.

According to the probable-error test of significance, tests 1, 7, 9, and 12 were significant. The interpretation purported that a correlation of .50 was of little value for forecasting.

Barnette (3:93-100), of the Pace Institute, found ratings on the Strong Vocational Interest Blank for students enrolled in accounting and business administration, in part:

Accountancy Interests--A, B, C Percentage Scores

Form B, N 57	Acct.	Office Clerk	Y.M.C.A.	Math.	Physics
A	40	47	-	-	2
B	46	46	23	14	5
C	14	7	77	86	93

Form M, N 25	Acct.	Pro.Mgr.	Pur.Agt.	Pers.Mgr.	Adv.
A	32	12	36	8	--
B	68	68	60	40	40
C	--	20	4	52	60

"On Form B the keys for accountant and office clerk show considerable similarity. More A's are earned in the latter, the less 'professional' occupation; likewise, there are fewer C's." Separation of business occupations from nonbusiness ones appear in Form M, as well. "Presumably if the blank were administered and scored during the first semester of business school rather than the fourth, more C's would be in evidence."

The study then compared:

> The expected tendency of C.P.A.'S scoring at the same or higher level on accountancy interest is confirmed; most accountants, again expected, receive a lower score on C.P.A. interest than they do for their own specialty.

The American Institute of Accountants (20:3) published the Fall, 1947 results of the Orientation Test. The test was used in the following study and will be described in Chapter III. Summarization data using raw score figures made on Forms A and B by first-year accounting students in twenty-one colleges included:

	Form A	Form B
Total	9049	7271
Q3	63.9	67.6
Md.	49.9	52.6
Q1	37.2	38.3
Range	1-123	0-120
10 o/ile	26.8	26.5
90 o/ile	78.2	81.4

> The total scores range from 1 to 123 on Form A and from 0 to 120 on Form B...Forms A and B are rather closely similar in difficulty, but Form B is slightly easier in both verbal and quantitative score. Likewise the variability on Form B seems to be a little greater than on Form A.

The data for the first-year students and for the second- and third-year students tend to confirm these observations. However, for practical purposes, it appears that the two forms could be used interchangeably, if the fact is kept in mind that, on the average, students can be expected to be two or three points higher in total score on Form B than on Form A.

...the first-year level is 37.2 for Form A and 38.3 for Form B...that the tenth percentile...is 26.8 on Form A and 26.5 on Form B. It may be helpful for users of this test to keep in mind the fact that if a first-year accounting student receives a total raw score of 35 or below he will be in the lowest quarter of the group on the basis of the national norms and that if he obtains a score of 25 or below he will fall within the lowest 10 per cent...Individual colleges may wish to note the tenth and twenty-fifth percentiles of the distribution of their own students. Sufficient research has been done to show that, in general, very few students whose total scores on the Orientation Test fall within the lowest quarter of their class are able to make grades of A or B in the study of accounting and that almost none of those in the lowest 10 per cent obtain grades that high. A corollary to this statement,...is that a very large proportion of the failures come from those low-scoring groups. (Form B was used by the Boston University College of Business Administration in the fall of 1947, the group on which the following sample study is based.)

V. SUMMARY OF RELATED RESEARCH

The research found a spread from approximately .40 to .80 in correlations between college grades and various criteria. First-semester marks were still the best single prediction of second-semester marks--r of .78, E of $\pm$-.219; use of multiple correlations increased the r to .836 and E to $\pm$.292.

Errors in measurement were found to be less when numerical grades by fives were used, instead of the five-letter-grade system. Also, stabilization of the criteria would increase when objective achievement tests supplemented subjective judgment.

Measures in vocational education and engineering had slightly higher forecasting efficiencies than those of other fields. Van Slyke's investigation of advanced accounting students obtained correlations under .50, an r of little value for forecasting.

Accounting students tended to obtain higher scores in business interests than in nonbusiness interests, as revealed on the Strong Vocational Interest Blank.

The American Institute of Accounting Orientation Test review revealed the national norms or raw score, 35, as the twenty-fifth percentile and raw score, 25, as the tenth percentile. Very few students within the twenty-fifth percentile made an A or B; none of the lowest tenth percentile obtained the honor status. A very large proportion of the failures came within the lowest scoring group.

Investigation into the direction of the relationship of guidance measures to first-year accounting at Boston University College of Business Administration will follow. An inclusion of the Normal (Probability) Curve, its application to the critical ratio, as well as definitions of some of the terms as used in the study were thought to be desirable; for convenience, they will be found in the Appendix.

CHAPTER II

PLAN OF STUDY

I. DESCRIPTION OF THE VARIABLES

The factors affecting accounting achievement were considered in the study from the point of view of guidance tests that were given in September, first-semester accounting grades, and the influence of bookkeeping experiences prior to college entrance.

The California Test of Mental Maturity, Advanced S-Form (6) tested intelligence, with power as its main factor. The scores yielded were nonlanguage, language, and total scores. The nonlanguage area subdivided into three scored sections: identification of rights and lefts, spatial relations, and analogies. Likewise, the language division segmented into the three scored sections of arithmetical reasoning, logical thinking, and vocabulary. The testing time, in practice, approximated fifty-five minutes.

The Nelson-Denny Reading Test, Form B (17) test of speed in the rhetoric area scored separately: vocabulary and paragraph comprehension, also providing a total score. Form B was considered to be slightly easier than its alternate, Form A. The testing time of thirty minutes was allocated as follows: ten minutes for the vocabulary and twenty minutes for the

comprehension section.

The Michigan Vocabulary Profile Test (14) of factual knowledge provided a total score and a vocabulary score for each of the eight areas of human relations, commerce, government, physical science, biological science, mathematics, fine arts, and sports. As the test was untimed, measurement was on the basis of power.

The Minnesota Vocational Test for Clerical Workers (15) measured one phase of clerical ability, surmised from the presentation of pairs of numbers and pairs of names. The number wrong were subtracted from the number right for each division and also the corresponding percentage of error under each was given. The time allotment was only fifteen minutes.

The Revised Minnesota Paper Form Board Test (21) measured ability to picture spatial relations. The paper and pencil test consisted of two-dimensional figures. The time allowed was twenty minutes.

The Kuder Preference Record (12) test of interest covered twelve pages of questions presented in groups of three items each, requiring choices to be made. Scores revealed the testee's immediate interpreted preference along the following interests: mechanical, computational, scientific, persuasive, artistic, literary, musical, social service, and clerical. There was no time limit.

The American Institute of Accountants Orientation Test Form B (2) was a broad-range, two-form aptitude test designed

for use at all college levels and for employment purposes. Verbal, quantitative (including figures, graphs, and computation items) and total scores made up the orientation test that was scored by the American Institute of Accountants. The testing time required about fifty minutes.

Supplementary information for an accounting program is being experimented with, now, by the American Institute of Accountants. Traxler (22) described three levels of achievement tests and typical accounting interest profiles obtained by using the Strong Vocational Interest Blank for Men. The tests of orientation, achievement levels, and professional interest comprise the objective investigation factors upon which the Institute has been concentrating with the co-operation of numerous contributing colleges. A regional office for testing and consultation with accounting firms and individuals has been set up in one city, at least, with the hope of expansion to other cities. A file of all test results is being maintained in New York City for transmittal of ratings to a prospective employer, upon the testee's signed request.

Freshman Accounting First-Semester (A1-2) Grades (18) gave four credit hours for achievement in Accounting Theory--Elementary, at the end of the first semester. The subject was a prerequisite to Accounting Theory--Advanced (A3-4), also offering four credit hours. All of the grades included in the sample study were of those students who were on the record as having received a completion grade at the end of the year.

Prior Bookkeeping Training students were those who were known to have studied bookkeeping in high school or other institution or had bookkeeping work experience. Eighteen of the sample of eighty-eight were included in the category. No Prior Bookkeeping Training students included seventy of the sample.

II. DESCRIPTION OF THE CRITERION

The Freshman Accounting Second-Semester (A3-4) Grades were a sample of eighty-eight first-year male students in the Accounting Theory--Advanced (A3-4) class in May, 1948. The cases were considered typical Boston University College of Business Administration freshmen. Figure 1 on the next page shows the A3-4 grades distribution of the sample in comparison with the 739 students at the end of the year. The superimposed population curve shows the relative normalcy of the sample distribution to the freshman population.

Quaid (19:352), in commenting on the effect of increasing the number of cases in a sample, specified:

> The size of the group, beyond the number required to give a fairly smooth curve of distribution, is important only to the extent that it reduces the sampling errors.

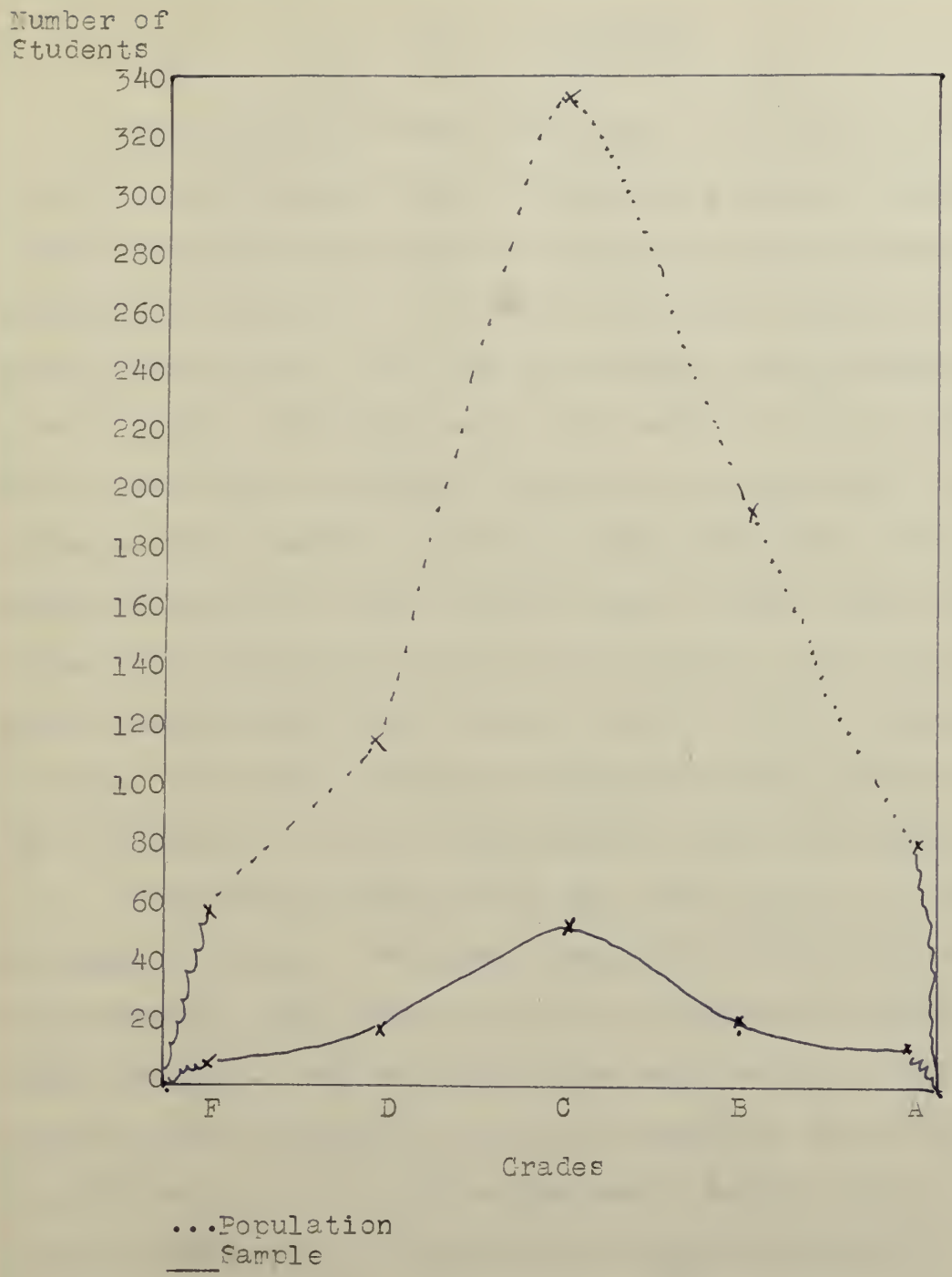

FIGURE 1

BOSTON UNIVERSITY COLLEGE OF BUSINESS ADMINISTRATION
FRESHMAN ACCOUNTING SECOND-SEMESTER (A3-4) POPULATION
AND THE SAMPLE OF EIGHTY-EIGHT FRESHMEN USED IN THE STUDY

III. PROCEDURE

The gathering of the data began by obtaining from the second-semester class lists of Accounting Theory--Advanced (A34) the names and grades of possible typical freshmen accounting students of the Boston University College of Business Administration. Of the 739 students, one hundred cases were recorded, using the sample procedure of one in every seven. When a noticeably irregular name had to be replaced, as in the instance of a student not having taken the tests at the scheduled time, the next name was used. Great pains was taken to keep the sample typical of the students. Of the one hundred cases, eighty-eight were finally considered to be typical male freshmen first-year College of Business Administration students who had taken all of the tests used in the accounting study.

An individual data sheet was then compiled for each of the sample testees. To permit comparison among test scores, the standard score, rather than the raw score, was the one used where possible. The standard score mean was set at 50, with standard score deviations figured in units of +-10 points. The standard scores of the Kuder Preference Record tests and the American Institute of Accountants Orientation Test had to be compiled. They were based, therefor, on the test means and deviations of the sample rather than the 1947 population. The raw scores were retained, rather than changed to standard

scores, in the Percentage of Error scores under the Number and Name sections of the Minnesota Vocational Test for Clerical Workers, inasmuch as the Errors tended to be U-shaped distributions rather than linear. Avoiding the complications arising from use of zero, the point values given to grades for use in the study are: A = 5, B = r, C = 3, D = 2, F = 1.

Development began with statistical descriptions of the distributions. Measures of central tendency included the median and the mean. Reliability of the mean was evidenced in the statistics of the standard error, probable error, and confidence limits. Each confidence limit figure determined, according to use by Garrett (11:188), the t-amount added or subtracted to the obtained statistic in question, within which the true statistic should recur in 95 per cent of the cases. The designated .05 and .01 chance levels were accepted as standard for most experimental work. Deviations from the mean were obtained in standard form through use of the standard deviation. Variability from the means among the statistics were placed in comparable terms through use of independent units, or otherwise called absolute numbers. Garrett (11:68) instructed:

> V (the coefficient of variation) is most useful, perhaps, in comparing the variability of a group upon the same test administered under different conditions...the zero point here, at least, remains substantially constant...V may also be used to compare two or more groups on the same test... (If we compare different mental tests) it should be made plain that the V's refer only to the specific scales upon which performance has been measured.

The next undertaking was inquiry into the correlations between the variables and the criterion. The direction of linear relationship between the variables and the criterion were found by using the Pearson Product-Moment r correlation chart similar to that in Adkins (1:Face 106). As mentioned previously in the study, the sample distributions of the Percentage of Error variables tended to be curvilinear, U-shaped. Garrett (11:132) (11:365-374) interprets:

> U-shaped distributions, like J-curves, are probably more often encountered in the measurement of social and personality traits than in the measurement of mental abilities...
>
> It sometimes happens in mental measurement, however, that the relationship between two variables is definitely non-linear; and when this is true, r is not an adequate measure of the degree of correspondence or correlation. When the regression is non-linear, a curve joining the means of successive arrays (in the columns, say) will fit these mean values more exactly than will a straight line. Hence, should a truly curvilinear relationship be described by a straight line, the scatter or spread of the paired values about the regression line will be greater than the scatter about the better-fitting regression curve...For this reason, an r calculated from a correlation table in which the regression is curvilinear will <u>always be less</u> than the true relationship.

Therefore, the significance of the non-linearship of the two tests were investigated by the chi-square test as found on pages 372-373, and the corrected curvilinear correlation ratios η were found, affording comparisons with the obtained coefficient of correlation r.

Reliability of the correlations were compared by two methods: the well-known "four times the probable error" and by the null hypothesis method of assuming no difference between

the figures and reoccurrence until shown that the indicated difference due to other than chance is significantly large. Significant limits for the purpose of the study are set at the .05 chance level.

The third consideration observed the critical ratios of the differences between high and low achievers with significance acknowledged at the ninety-five per cent level. The statistical breach between the two groups at that point was granted due to an innate unlikeness, rather than just to chance. Garrett (11:199) explained the procedure of finding a critical ratio, or the reliability of the difference between two means as "dividing the obtained difference (between the means) by its standard error."

The final concern was with estimates, finding the best estimates for second-semester grades. Having the obtained statistics, the question of use for forecasting was subject to certain conditions. To estimate a second result from achievement on the first result, two regression lines could be developed. Accuracy of forecast from a regression equation, Garrett (11:321-339) found:

> ...depends directly upon the standard deviations of the two distributions and upon the degree of correlation between the two sets of measures. If the variability...is small, and the correlation...high, values can be predicted from known values...with a comparatively high degree of accuracy. However, when the variability of a test is large, or the correlation low (or when both conditions obtain), prediction from regression equations becomes so unreliable as to be almost valueless...When an investigator uses the regression equations for purposes of prediction,

he should always give the (standard error of estimate) of his estimated scores. The value of a forecast depends, first of all upon the size of the error of estimate; but it also depends upon the units of measurement, and upon the purposes for which the prediction is made...The correlation coefficient must be .87...before the standard error of estimate is reduced .50 below the σ of the test.

Fortunately correlation makes out better in forecasting the performance of groups than in predicting the most likely achievement of a given individual...But knowing the correlation between a test (or test battery) and some criterion of performance, he can forecast often with considerable accuracy the probable performance of various groups chosen from his distribution of test scores. The degree of accuracy in such predictions depends upon the size of the correlation coefficient...These (forecasting) tables are strictly accurate only when the distributions are normal both in the test and in the criteria of performance... Forecasting tables have considerable value in selecting personnel for business or other vocations.

Brogden (5:67) weighed the overall forecasting efficiency of r thus:

In evaluating efficiency of selection, the problem is that of comparing random or average choice with that obtained by selecting with some measuring instrument... If one-half of the total possible saving were effected by use of the predictor, the obtained value for the index of predictive efficiency should be .5; while, if one-fourth of the total possible savings were effected, the index should be .25.

In the light of the foregoing, the coefficient of forecasting efficiency (E) given by Garrett (11:337) was applied to correlations above $\pm$.60.

IV. SPECIFIC OBJECTIVES

The objectives, then, were:

1. To study the relationship between the variables of tests, A1-2 grades, prior bookkeeping training and no prior bookkeeping training with that of the A3-4 grades criterion.

2. To study the relationship between selected inter-correlations.

3. To investigate whether or not there appears to be any significant differences between the high and low achievers.

4. To submit, if possible, a "best estimate" of A3-4 grades that might be evidenced in high test correlations in the study.

CHAPTER III

MEASUREMENT FINDINGS

I. CENTRAL TENDENCIES AND DEVIATIONS

A statistical survey of the sample used in the study appears in Table IA and IB.

TABLE IA

MEASURES OF CENTRAL TENDENCY AND RELIABILITY OF SELECTED VARIABLES AND FRESHMAN ACCOUNTING SECOND-SEMESTER (A3-4) GRADES CRITERION

Variables and Criterion	**RS Mean	SS Mean	SS ±-SE	SS ±-PE	SS ±-CL	SS Mdn.
Cal Nonlang	33.61	52.86	1.12	.75	2.19	53.15
Cal Lang	48.15	49.50	.85	.57	1.66	48.64
Cal Total	81.80	51.68	.95	.64	1.86	51.97
N-D Voc	45.35	51.14	.95	.64	1.87	51.23
N-D Comp	48.50	51.82	.88	.60	1.73	52.57
N-D Total	93.86	51.27	.86	.58	1.68	52.46
Mich Voc	131.10	52.14	.83	.56	1.62	51.50
Cler Nos	117.80	49.64	.43	.29	.84	49.39
Err Nos	---	* 1.88	* .18	*.12	* .36	* 1.12
Cler Nas	128.20	49.18	1.21	.81	2.36	48.59
Err Nas	---	* 3.76	* .26	*.17	* .50	* 2.86
MPFB Spatial	44.08	51.37	1.10	.74	2.16	50.88
K Comp Int	41.85	50.27	1.05	.71	2.05	49.68
K Lit Int	54.80	50.05	1.05	.71	2.06	49.82
K Cler Int	63.49	49.45	1.12	.75	2.19	49.50
AIA Orient	---	50.00	1.04	.70	2.04	50.05
Grades (A3-4)		* 3.08	* .11	*.07		* 3.05
A1-2 Grades		* 3.31	* .09	*.06		* 3.31
Prior Bkpg.		* 4.00	* .16	*.11		* 4.00
No Prior Bk		* 3.13	* .10	*.07		* 3.11

*Raw Score Figures
**Raw Scores on Freshman Population

TABLE IB

MEASURES OF DEVIATION AND VARIABILITY OF SELECTED VARIABLES AND FRESHMAN ACCOUNTING SECOND-SEMESTER (A3-4) GRADES CRITERION

Variables and Criterion	**RS SD	SS SD	V
Cal Nonlang	4.47	10.48	19.82
Cal Lang	7.65	7.95	16.07
Cal Total	9.56	8.90	17.22
N-D Voc	12.65	8.96	17.52
N-D Comp	9.55	8.30	16.01
N-D Total	17.57	8.06	15.73
Mich voc	16.15	7.74	14.85
Cler Nos	25.00	4.02	8.11
Err Nos	-----	* 1.73	*91.90
Cler Nas	25.30	11.32	23.01
Err Nas	-----	* 2.40	*63.83
MPFB Spatial	8.64	10.32	20.09
K Comp Int	12.75	9.81	19.52
K Lit Int	5.78	9.84	19.66
K Cler Int	14.20	10.50	21.24
AIA Orient	-----	9.72	19.44
Grades (A3-4)		* 1.01	*32.92
A1-2 Grades		* .88	*26.69
Prior Bkpg.		* .67	*16.67
No Prior Bk		* .84	*26.96

*Raw Score Figures
**Raw Scores on Freshman Population

The mean and median corresponded closely throughout, revealing that the score average and the middle score do not vary to a great extent, with the exception of the Percentages of Errors in both the Number and Name sections of the Minnesota Vocational Test for Clerical Workers. Here the difference is proportionally large, hinting of the irregularity that will present itself upon further examination. The American Institute

of Accountants Orientation Test has the least difference, that of only .05. Attention is called to the previously mentioned fact that the standard scores (using 50 as the mean) are of the sample, rather than based on the population. The California (Nonlanguage) sample shows the greatest mean and median deviation from the standard score mean and median of the freshman population; consequently, the sample here might be considered the least representative.

The standard error indicates the reliability of the mean upon many repeated measurements, while the probable error suggests the reliability in .50 of additional cases.

The confidence limits indicate the range of the mean in .95 of the cases. The increase is in proportion to the increase in spread of the standard deviation scores. Attention is called to the large difference in standard deviations (4.02 and 11.32) of the Number and Name sections of the clerical test.

Variability (V) gives an overall absolute picture of the relationship between the measures of central tendency and the size of the standard deviation. The unusually large V's of the Percentages of Errors tests indicate further of the presence of irregular means. The statistics of the prior bookkeeping students show a smaller variability, while the mean is practically a grade higher, B grade, than that of the no prior bookkeeping students, C grade.

(As an aid in interpreting the measurement findings of the thesis in terms of test raw scores, the first column of

figures in Table IA and Table IB were inserted, showing previously obtained means and standard deviations on the population.)

II. CORRELATIONS: VARIABLES AND CRITERION

The correlations, obtained, appear in Table II:

TABLE II

CORRELATION COEFFICIENTS, PROBABLE ERRORS, AND TESTS OF SIGNIFICANCE BETWEEN TEST VARIABLES AND FRESHMAN ACCOUNTING SECOND-SEMESTER (A3-4) GRADES CRITERION

Variables	N	r	η	✓-PE	4 PE	Null H.
Cal Nonlang	88	.15		.071	.284	
Cal Lang		.16		.070	.280	
Cal Total		.20		.069	.276	-✓
N-D Voc		.13		.071	.284	
N-D Comp		.22		.069	.276	✓
N-D Total		.19		.070	.280	-✓
Mich Voc		.15		.071	.284	
Cler Nos		-.16		.070	.280	
Err Nos		-.23		.069	.276	✓
A3-4 on Err			-.40	.060	.240 -	✓✓
Err on A3-4 **			-.37	.062	.248 -	✓✓
Cler Nas		.09		.065	.260	
Err Nas		-.18		.070	.280	
A3-4 on Err			-.40	.060	.240 -	✓✓
Err on A3-4 **			-.32	.063	.252	✓
NPFB Spatial		.20		.069	.276	-✓
K Comp Int		.09		.072	.288	
K Lit Int		-.20		.069	.276	-✓
K Cler Int		-.09		.072	.288	
AIA Orient		.25		.068	.272	✓
A1-2 Grades	88	.62		.044	.176 -	✓✓
A1-2 Prior Bkpg.	18	.61		.102	.408 -	✓✓
A1-2 No Prior Bkpg	70	.67		.044	.176 -	✓✓

* *Not significantly curvilinear

From Garrett's (11:299) Table 49:
-✓ Almost significant
✓ Significant on the .05 chance level; r = .21
✓✓ Significant on the .01 chance level; r = .27

The correlation technique used was that of the linear Pearson Product-Moment r. The curvilinear correlation ratio n was also included in the Percentages of Errors (Numbers) and (Names) of the Minnesota Vocational Test for Clerical Workers to reveal the more explicit characteristics of the interaction upon each in a curvilinear relationship.

A low medium positive or negative correlation prevailed over most of the variables, -.40 on the A3-4 grades' dependence on the Percentage of Error (Numbers) to +25 on the American Institute of Accountants Orientation Test. The strong area appeared in the relatively marked correlation in the +.60's of the A1-2 grades of the first semester in relation to the A3-4 grades of the second semester. The correlation of all the A1-2 grades of the second-semester students to their A3-4 grades was +.62. A separation of the first-semester grades on the basis of prior and no prior bookkeeping shows that the seventy students who had no prior bookkeeping may be slightly more indicative with the correlation of +.67 than is indicated by the +.61 of the few who had prior bookkeeping training.

Amongst the higher of the low positive correlations appeared the California Mental Maturity (Total), the Nelson-Denny (Comprehension), the curvilinear dependence of the Percentage of Errors (Names) on the A3-4 grades, the Minnesota Paper Form Board test dealing with spatial relations, and the American Institute of Accountants Orientation Test. Likewise, the higher of the low negative correlations brought forth the

inverse relation of Percentage of Errors (Numbers) on the A3-4 grades, as well as marking the tendency of those who show an interest in literature to receive a low grade in accounting.

The four-times-the-probable-error test of the reliability of the correlations indicates the relation of the A3-4 grades from the Percentage of Errors (Numbers) and from the Percentage of Errors (Names), as well as the correlations between all of the first-semester grades, the prior bookkeeping training and the no prior bookkeeping with that of the second-semester grades.

The null hypothesis test of reliability calls attention to the same correlations as being reliable in at least .99 of the cases. The reliability of correlations near the .95 level are, strangely enough, of those tests described earlier as being among the higher correlations.

Curvilinear relationships of the dependence of the A3-4 grades on Percentages of Errors were found significant according to Garrett's (11:373) application of the Chi-square test for non-linearity of regression. The correlation ratio η of both is -.40. The significant curvilinear relationship indicates that low scores on the Percentages of Errors (Numbers and Names) occur on the extremes of A3-4 grades, while the average student tends to make the maximum percentage of errors.

Curvilinear relationships of the Percentages of Errors dependence on A3-4 grades were found insignificant; the deviations from r could have arisen from sampling accidents.

Points on the effect of accuracy on achievement that arise from

the Percentages of Errors scores could very well lead to a special study on the subject of accuracy.

III. INTERCORRELATIONS: SELECTED VARIABLES

Intercorrelations are shown in Table III.

TABLE III

INTERCORRELATIONS BETWEEN THE AMERICAN INSTITUTE OF ACCOUNTANTS ORIENTATION TEST AND SELECTED VARIABLES

Variables	N	r	η	✓-PE	4 PE	Null H.
Err Nos	88	-.05		.072	.288	
AIA on Err **			-.15	.071	.284	
Err on AIA **			0	.062	.248	
Err Nas		-.06		.072	.288	
AIA on Err			-.50	.054	.216 -	✓✓
Err on AIA **			-.21	.069	.276	
Al-2		.29		.066	.264 -	✓✓

** Not significantly curvilinear

-✓ Almost significant
✓ Significant on the .05 chance level; r = .21
✓✓ Significant on the .01 chance level; r = .27

The Pearson Product Moment Coefficient r showed a very slight negative relation between Percentages of Errors on the Minnesota Vocational Test for Clerical Workers and the American Institute of Accountants Orientation Test. The curvilinear correlation ratio n on the tests double asterisked were found to be insignificantly different from the correlation r.

The curvilinear correlation ratio η of the Percentage of Error (Names) was found significantly different from the corre-

lation coefficient r. Likewise, the correlation ratio was found reliable by the probable error test and the .01 chance level on the null hypothesis test.

Calling to mind Table II, grades again proved to be among the highest of the correlations, r. The A1-2 grades of the first semester correlated .29 with the American Institute of Accountants Orientation Test, a slight increase over the American Institute of Accountants Orientation Test r of .25 with the A3-4 grades of the second semester.

IV. CRITICAL RATIOS

In determining the difference between the high and low achievers in the study, those compared were twenty-five A and B grade students and twenty-one D and F grade students.

TABLE IV

CRITICAL RATIOS OF DIFFERENCES IN TEST VARIABLES BETWEEN HIGH AND LOW ACHIEVERS IN FRESHMAN ACCOUNTING, SECOND SEMESTER (A3-4)

Variables	25 High Achievers M	SD	21 Low Achievers M	SD	Diff. M	SE Diff. M	CR
Cal Nonlang	56.54	7.86	50.64	11.52	5.90	3.04	1.94
Cal Lang	49.18	8.97	45.88	7.52	3.30	2.49	1.33
Cal Total	53.02	8.57	47.60	10.14	5.43	2.86	1.89
N-D Voc	52.14	9.95	49.88	7.70	2.66	2.67	1.00
N-D Comp	55.10	7.24	50.26	9.85	4.84	2.65	1.82
N-D Total	53.66	8.87	49.69	9.26	3.97	2.75	1.44
Mich Voc	53.50	7.84	50.07	9.66	3.43	2.69	1.28
Cler Nos	52.06	8.38	50.45	11.10	1.61	3.02	.53
Err Nos	1.35	1.95	2.08	1.24	- .73	.48	-1.51
Cler Nas	50.30	11.26	48.93	11.11	1.37	3.38	.41
Err Nas	3.04	2.29	3.98	2.60	.94	.75	-1.26
MPFB Spatial	55.58	10.25	51.21	10.44	4.37	3.14	1.39

TABLE IV--Continued

Variables	25 High Achievers M	SD	21 Low Achievers M	SD	Diff. M	SE Diff. M	CR
K Comp Int	50.62	12.16	46.26	7.47	4.36	2.99	1.46
K Lit Int	47.26	8.99	50.64	10.34	-3.38	2.95	-1.15
K Cler Int.	44.74	10.62	49.12	11.24	-4.38	3.32	-1.32
AIA Orient	52.54	11.19	46.07	8.03	6.47	2.92	2.21 *

Table IV reveals the findings of the differences on the test measures. In keeping with the critical ratio of significance on the .05 level established as significant for purposes of the study, the American Institute of Accountants Orientation Test was found to be significant at 2.21. The figures surpassed the necessary 2.02 of the small-sample Student's Distribution table in the columns for forty-six students, the total compared.

Table V shows the findings of the differences in other variables: inferences obtainable from the first-semester grades and also from the point of view of prior and no prior bookkeeping training.

The critical ratio figures which must be reached to indicate a significant ratio of difference between high and low achievers were obtained from the Student's Distribution Table. Of the second-semester students, there were thirty-eight high achievers with A or B grades and eighteen low achievers with D or F grades in Freshman Accounting, First Semester (A1-2). The critical ratio of group difference, 5.36, far exceeds the necessary 2.67 as indicative of significance on the .01 level.

TABLE V

CRITICAL RATIOS OF DIFFERENCES IN OTHER VARIABLES: BETWEEN (1) HIGH AND LOW ACHIEVERS IN FRESHMAN ACCOUNTING, FIRST SEMESTER (A1-2); (2) PRIOR AND NO PRIOR BOOKKEEPING TRAINING

Variables	High Achievers M	High Achievers SD	Low Achievers M	Low Achievers SD	Diff. M	Diff. M	CR
A1-2 Achievers and A3-4 Marks N's[1] = 38, 18	3.79	.89	2.39	.89	1.40	.26	5.36 ++
A1-2 Achievers and AIA N's[1] = 38, 18	50.29	10.25	43.94	6.27	6.35	2.27	2.80 ++
Prior and No Prior (A1-2) N's[2] = 18, 70	4.00	.67	3.13	.84	.87	.19	4.61 ++
Prior and No Prior (A3-4) N's[2] = 18, 70	3.17	.96	3.06	1.03	.11	.26	.42

"Student's Distribution" Table, from Garrett (11:190)

N's[1]

\+ Significant on the .05 level, CR = 2.01
++ Significant on the .01 level, CR = 2.67

N's[2]

\+ Significant on the .05 level, CR = 1.99
++ Significant on the .01 level, CR = 2.63

To a lesser extent, the critical ratio of group difference, 2.80, between achievement on the American Institute of Accountants Orientation Test of the high and low achievers in A1-2, adequately surpasses the necessary 2.67 of the .01 significance level. The standard deviations using the American

Institute of Accountants Orientation Test are, by far, much larger than on the A3-4 grades. The standard deviations of .89 on the latter indicate a much closer cluster of scores about the means than the standard deviations of 10.25 and 6.27 of the American Institute of Accountants Orientation Test.

The difference in the first-semester grades between those eighteen who had prior bookkeeping and those seventy who did not, again reveals an excess in the critical ratio of 4.61 over the necessary 2.63. In contrast, the critical ratio of the group difference in the second semester of those who had prior bookkeeping and those who did not is noticeably insignificant, the .42 being far below the necessary 1.99 at the .05 level.

Attention is drawn to the mean of 4.00 in the first semester of those who had prior bookkeeping and the respective drop to a 3.17 mean in the second semester, a difference of practically a whole grade--B in the first instance and C in the second. There were no D grades in A1-2 of those having had prior bookkeeping, accounting for the difference in means. Neither group was affected by F grades, for those students did not advance into the second-semester course. The standard deviations in the first semester, accordingly, show a closer cluster about the mean for those who had prior bookkeeping than for those who did not; the second semester, on the contrary, shows a closer cluster about the mean of those students who had no prior bookkeeping.

Findings for the interest manifested in critical ratios

between high and low achievers on the American Institute of Accountants Orientation Test with regard to certain other factors appears in Table VI. There were eighteen high achievers who received at least a standard score of 60 and fourteen low achievers who obtained a standard score below 40.

TABLE VI

CRITICAL RATIOS OF DIFFERENCES IN SELECTED VARIABLES BETWEEN HIGH AND LOW ACHIEVERS ON THE AMERICAN INSTITUTE OF ACCOUNTANTS ORIENTATION TEST

Variables	High Achievers			Low Achievers			Diff	SE Diff	CR
	N	M	SD	N	M	SD	M	M	
Err Nos	18	1.30	1.03	14	1.42	1.20	-.12	.42	-.30
Err Nas	18	3.37	2.80	14	3.74	2.12	-.38	.90	-.42
A1-2 ++	18	3.78	.63	14	3.00	.85	.78	.28	2.82

"Student's Distribution" Table, from Garrett (11:190)
+ Significant on the .05 level, CR = 2.04
++ Significatn on the .01 level, CR = 2.75

The negative critical ratios on the Minnesota Vocational Test for Clerical Workers Percentages of Errors showed some tendency towards fewer errors by the higher scores on the American Institute of Accountants Orientation Test, but no difference significant to the .05 chance level of 2.04 was evidenced. However, the critical ratio difference of 2.82 in first-semester grades (A1-2) between the high and low achievers on the American Institute of Accountants Orientation Test passed the .01 chance level of 2.75.

CHAPTER IV

SIGNIFICANCE OF THE FINDINGS

I. CORRELATIONS

The correlations of the selected measures varied from a marked positive correlation to very little correlation and then in the opposite direction to marked negative correlations. The correlations for the most part indicate the direction or relative trend with opportunities for comparison of individual measures with relation to achievement in freshman accounting. Of the various measures, the first-semester grades showed the highest relation to second-semester grades, as Quaid was reported in Chapter II to have found in his study. The American Institute of Accounting Orientation Test showed the highest relation of the test measures to the first-and second-semester grades, respectively. The low test correlations should be interpreted liberally, in view of the purposes of the study, and held tentatively until other studies can be made. The marked correlations of the first-semester grades are high, in comparison with findings in the chapter on related research, Chapter II, which revealed the fact that correlations in special fields and subjects were lower than for general scholarship grades.

Surprising findings occurred in the negative direction

of the several aspects of the Minnesota Vocational Test for Clerical Workers. The negative Kuder Literature interest showed an almost significant relationship on the .05 chance level of the null hypothesis test, but the low negative r of the Kuder Clerical interest was definitely not significant.

The low degree of relationship of the measures occurring, with the exception of the first-semester marks, may be due to effects beyond the scope of the criteria. Influencing factors include selectivity of the group, the external factors of finance, home problems of many of the veterans as well as the nonveterans, volition, study habits, college orientation, and personality factors.

The findings should be considered as relating only to freshman accounting achievement, one of the first stepping stones to the various business majors, including accounting.

II. CRITICAL RATIOS

After finding the direction of relationship as exhibited in the correlations, significant differences between high and low achievers were investigated with significance set on the .05 level of chance occurrence. Indication was made when the .01 level of significance was reached. The significant figures were based on the number in the group and were taken from the "Student Distribution" table for small samples.

<u>Five per cent level of significance</u>: The differences of A3-4 high and low achievers on the American Institute of

Accountants Orientation Test was significant here.

One per cent level of significance:

1. The differences of the A1-2 high and low achievers were significant with reference to (1) A3-4 grades and (2) the American Institute of Accountants Orientation Test.

2. The difference between prior and no prior bookkeeping in the A1-2 grades was significant.

3. The difference between high and low achievers on the American Institute of Accountants Orientation Test was significant on the A1-2 grades.

In view of the fact that low obtained correlations are considered in a tentative manner, awaiting further studies, especially of those measures expected to yield higher correlations, the influence of the critical ratio findings might well take precedence over the correlations obtained.

The critical ratio of the first-semester grades strengthened its correlation findings.

The effect of prior bookkeeping training was significant in the first semester, but not in the second.

The evidence that the difference between the high and low achievers on the American Institute of Accountants Orientation Test was significant on the .01 level during the first semester and on the .05 level during the second, corroborated the measure's apparent justification for first place among the test correlations.

III. GROUP ESTIMATES OF SECOND-SEMESTER (A3-4) GRADES

Correlations of +-.60 or over in relation to the crite-

on of Freshman Accounting, Second-Semester (A3-4) grades were found in the eighty-eight A1-2 grades, an r of .62; in the A1-2 prior bookkeeping group, ar r of .61; and in the A1-2 no prior bookkeeping group, an r of .67.

According to the "coefficient of forecasting efficiency" (E) formula used by Garrett (11:337):

A1-2 on A3-4 had an E of .22;
A1-2 prior bookkeeping on A3-4 had an E of .21; and
A1-2 no prior bookkeeping on A3-4 had an E of .26.

The general statement may be submitted that within the findings of the sample, group forecast would be accurate from one-fifth to one-fourth of the time. The forecasting table for actuarial purposes recognized that a correlation must be above .87 for the forecasting efficiency to be greater than .50.

IV. LIMITATIONS AND SUGGESTIONS

Limitations:

1. The group was highly selective in that it comprised of male freshman students at a college of business administration in a post-war era, at a time of highly competitive college attendance.

2. The post-war period of adjustment, in its many ways, affected standardization of instruction techniques, change in course content, increased demands on college instructors, facilities, and students, as well as in external causes in everyday living.

3. The number of instructors was numerous.

4. The size of the sample was small.

5. No study was found using similar variables with the criterion of first-year accounting students of all majors at a college of business administration.

6. The number of students of the sample having had prior bookkeeping was only eighteen; whereas, those who had no prior bookkeeping numbered seventy.

7. Although in keeping with the purposes of the study, the measures and letter grades included broad intervals.

Suggestions:

1. Further investigation of the curvilinear relationship between grades and accuracy, as already evidenced in the Minnesota Vocational Test for Clerical Workers

2. Further study of the effect of accuracy and personality on achievement

3. Study of changes in volition as affecting accounting grades

4. Further study of the marked correlation between first- and second-semester grades, using numerical scores rather than five-letter grades, thus permitting a more accurate use of regression equations

5. Further study and corroboration of the marked correlation between semester accounting grades and sequel courses

6. Further investigation of types of tests and combinations, as affecting freshman accounting

7. Investigation of college interest and character patterns of those successful in accounting subjects

8. A study of the percentage of graduates who entered the profession of their college major

9. Conduct experiments with additional tests not now in use at the college

10. A study for improvement of accounting course content

11. Correlations with other fields, such as management and marketing

12. Further study of the yearly American Institute of Accountants Orientation Tests, Achievement Tests on various levels, and Interest Tests

13. Compare the Boston University College of Business Administration with other business administration colleges.

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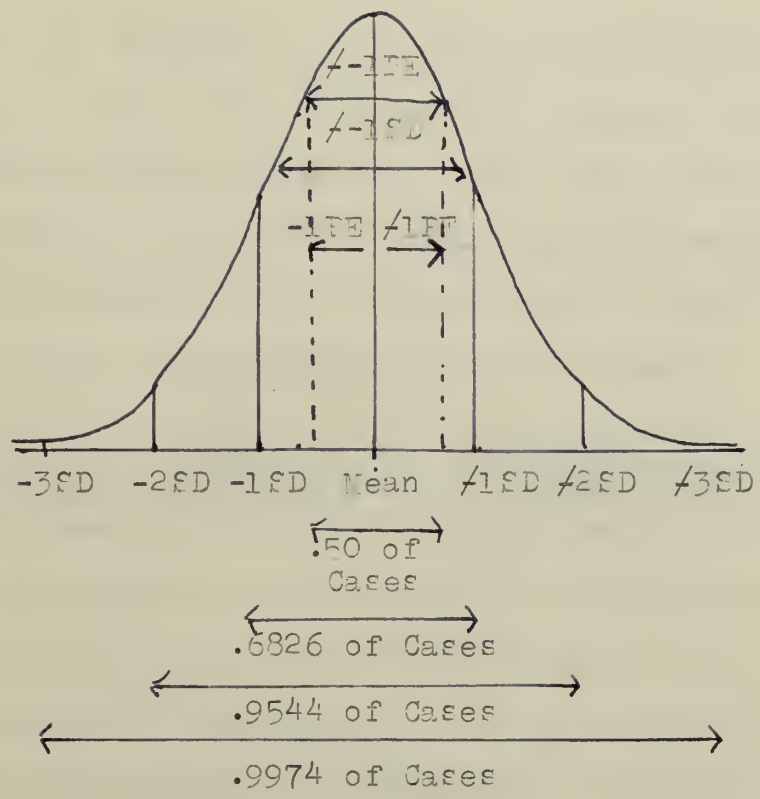

FIGURE 2

THE NORMAL (PROBABILITY) CURVE

Garrett (11:102,104) explained:

There are relatively few measures at the low-score end of the scale; an increasing number up to a maximum at the middle position; and a progressive falling off toward the high-score end of the scale.

The probability of a given event is defined as the expected frequency occurrence of this event among events of like sort--a ratio.

CRITICAL RATIO AND THE NORMAL CURVE

To find out whether or not there is an inherent difference between two groups due to other than chance happening, the derived difference figure (critical ratio) may be thought of as a deviation obtained by dividing the difference between the means of the two groups by the standard error of the difference between the means. The deviation figure provides:

+-1 (Standard) Deviations = 68.26 per cent of the cases
+-2 (Standard) Deviations = 95.44 per cent of the cases
+-3 (Standard) Deviations = 99.74 per cent of the cases
+-3+(Standard) Deviations = 100 per cent of the cases

A standard is selected at which point the difference between the two groups has such a slight chance element that the difference is considered significantly due to other than chance. The figure selected depends on the scope and fineness of the sample groups in accordance with the following:

Deviations	(Large Sample)	Cases Resulting from Chance
+-1.960	(Standard)	5 out of a hundred
+-2.576	(Standard)	1 out of a hundred
+-3.000	(Standard)	.26 out of a hundred (or 1 in 376 cases)

TERMS DEFINED

From Glossary of Technical Terms--Adkins (1:267-280)

Correlation coefficient - any measure of relationship between two variables

Coefficient of forecasting efficiency (E) or coefficient of dependability - provides a quick estimate of predictive efficiency of an obtained r -- from Garrett (11:337)

Critical ratio - an index of the significance of a difference between two comparable measures

Dependent variable - a variable being estimated or predicted from another variable (or variables) called the independent variable. Also called criterion

Deviation - a gross score minus the mean of the distribution

Error of measurement - the difference between an obtained and the corresponding true score

Fluctuations of sampling - chance, irregular variations causing statistical results based on a sample to differ from those based on other samples and those applicable to the universe

Linear - capable of satisfactory representation by a straight line

Mean (M) - the sum of scores divided by the number of scores

Median (Mdn.) - the point or score value which divides the cases in a frequency distribution evenly or into an upper and a lower 50 per cent

Null hypothesis - asserts that no true difference exists... between samples -- from Garrett (11:232)

Pearson product-moment correlation coefficient (r) - a number between the values of -1.00 and +1.00 which expresses the degree of relationship between two variables

Probable error (P.E.) - a value equal to 0.6745 the standard error and such that a range of one probable error on either side of the mean of a normal distribution includes exactly 50 per cent of the cases

Raw score - a test score as originally obtained, before any transmutation or statistical treatment

Reliability - The accuracy with which a measuring device measures what it measures

Skewness (Sk.) - The extent to which the shape of a frequency distribution or curve departs from symmetry. When skewness is positive, the mean is ordinarily larger than the median and the mode; when negative, the mean if ordinarily smaller

Standard deviation - a measure of variability obtained by taking the square root of the mean of the squares of the deviations of the scores from their mean

Standard error - the estimated standard deviation of a stais-tical measure that would be obtained if the measure were repeated over and over again

Standard score (z) - a deviation from the mean expressed in terms of standard deviation of the distribution; a gross score minus the mean, divided by the standard deviation. Also called z-score and sigma score

Validity - the extent to which a test or other variable measures what it is supposed to measure