

THE ASSESSMENT OF APTITUDES FOR SUCCESS
IN THE GENERAL CLERICAL OPTION OF
THE BUSINESS AND OFFICE
EDUCATION PROGRAM

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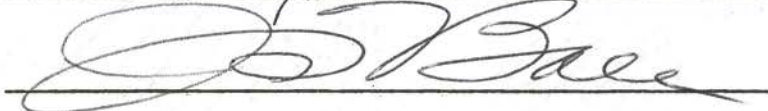
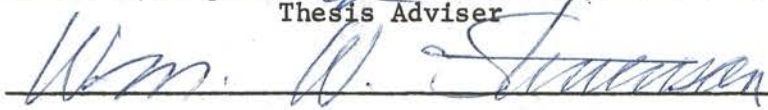
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CHAPTER I

INTRODUCTION

A study undertaken to determine the manpower needs in Oklahoma (Oklahoma Employment Security Commission, 1964) pointed out that one of the major occupational groups in Oklahoma was office occupations. Employment projections indicated that office workers would constitute approximately 18 per cent of the Oklahoma labor force through 1975. Business education programs have been developed in the area vocational-technical schools to help meet the expanding manpower needs in this occupational area.

The cost in terms of time and money to prepare competent office workers is comparable to that required for training many other types of skilled workers. In the light of this expense it would be helpful to educators if some assessment could be made prior to enrollment to determine if students interested in the General Clerical Option had the requisite abilities to make the most of the training. The need to utilize meaningful data for assisting students to plan courses of action in line with abilities and interests tends to be more important than ever in the light of curtailed educational resources and the extensive stress on accountability.

It is of primary importance that the students be given every opportunity to determine where their strengths lie in order that they experience the fullest opportunities to get the most out of the

educational programs they select. One of the first steps in this direction is to make available tests which have been validated against suitable criteria of performance for counseling and guidance purposes. The prediction study undertaken in this investigation attempts to achieve this objective for the General Clerical Option.

Statement of the Problem

Students in various school settings are having increased opportunities to work with counselors for the purposes of (1) clarifying educational-vocational objectives and (2) resolving emotional difficulties. As implied above the responsibility placed upon counselors to do more effective work demands that improved data be acquired through research so that recommendations can be based upon more refined findings.

At times counselors recommend programs of training based upon test outcomes which have not been adequately validated against appropriate criteria of performance (Nunnally, 1970). Recommendations are predicted generally upon the face validity of the measuring devices utilized. Such educated guesses have their limitations.

A review of the literature shows that at the present time no satisfactory yardstick is available, based upon tests, grades, or a combination of the two, which predicts the probable success of students in programs similar to that of the General Clerical Option of the Business and Office Education Program. The research presented in this study is concerned with determining the best combination of measures for predicting success in the General Clerical Option.

Purposes of the Study

The major purpose of the investigation was to determine the extent to which a selected group of variables predicted the performance of senior high school students who were enrolled in the General Clerical Option of the Business and Office Education Program at two area vocational-technical schools in Oklahoma, referred to as Schools A and B. The measures employed were the overall high school grade point average based upon the first three years of high school and data obtained from selected tests of the General Aptitude Test Battery. The criterion was the letter grade in the General Clerical Option.

Specifically the purposes of the investigation were: (1) to examine the relationships among the predictors and the criterion to (a) assess overlap among the predictors, and (b) to determine the degree to which the measures correlated with the criterion of performance; (2) to assess the magnitude of the relationship between the battery of predictors and the criterion (the multiple R); (3) to determine the regression weights which indicated the weight each measure contributed to the prediction of the criterion; and (4) to make recommendations as to how the findings might be used by counselors in assisting students to consider the General Clerical Option as preparation for a career.

Findings useful in making the work of the counselor more effective may be of great import in influencing the educational-vocational plans of students.

Assumptions

The assumptions underlying this study may be outlined as follows:
(1) that the students employed in the research are representative of

those in the other vocational-technical schools in the state; (2) that the program of instruction in the two schools is comparable to that in other state vocational-technical schools; (3) that the criterion of performance is a reliable and valid measure of the students' productivity in the course; and (4) that the measures employed for predicting the criterion are reliable tests that have a positive relationship with the criterion.

Delimitations of the Study

The investigation was restricted to data obtained from two area vocational-technical schools in Oklahoma, referred to as Schools A and B. The study was limited to the classes held at the centers in the school years 1970-71 and 1971-72.

The General Clerical Option was selected because the number of students in the Stenographic Option was too small at the two schools during the years selected to undertake a regression analysis.

Limitations of the Study

The criterion of performance was somewhat narrow, represented by a final grade in the senior year in the General Clerical Option of the Business and Office Education Program.

Data for the investigation were available from two schools. The results of the analyses may lead to conclusions which are representative of samples from particular geographic areas and limit the generalizations to be drawn from the findings.

Definition of Terms

Area Vocational-Technical Schools. These are centralized schools which provide vocational education opportunities for students from several surrounding high school districts. Students, generally, are transported by bus to the "area vocational-technical school" for one-half day of instruction in vocational and related subjects and returned to the home school for the remaining half-day for instruction in general education subjects and for other cooperating school activities (Gardner, 1972).

Cooperating School. The school in which the area student is regularly enrolled. Credits earned at the area school apply at the cooperating school toward secondary school graduation. The student who attends the area school is carried as a full-time student at the cooperating school.

Business and Office Education. Vocational education programs carried on by comprehensive high schools and area vocational-technical schools in the following areas: general clerical, stenographic, accounting, graphics communications, and data processing.

General Clerical Option. A specialized business and office program which provides vocational training in advanced typewriting, filing, business and computational machines, duplicating, recordkeeping, written and oral communications, and other business procedures during the twelfth grade at the secondary school level.

General Aptitude Test Battery (GATB). A series of tests developed by the United States Employment Service. Form B, B-1002, consists of 12 tests which measure nine aptitudes important for successful performance in a wide variety of occupations. Eight are paper and pencil

tests and four are apparatus tests. The nine aptitudes measured by the GATB are: intelligence, verbal, numerical, spatial, form perception, clerical perception, motor coordination, finger dexterity, and manual dexterity (GATB Manual, Section III, 1970).

Predictors. The following variables from the General Aptitude Test Battery (GATB) were employed as predictors: G (Intelligence) which may be defined as general learning ability, as ability to reason and to make judgments, to do well in school; V (Verbal Ability) which involves the capacity to understand words and ideas associated with them, to use words effectively, to understand relationships between words and to present ideas clearly; N (Numerical Aptitude) which measures the ability to perform arithmetic operations quickly and accurately; P (Form Perception) which deals with the capacities to make visual comparisons and discriminations, to perceive detail; and Q (Clerical Perception) which involves ability to perceive detail in verbal or tabular material, to spot perceptual errors in words and number. In addition to the above the overall grade point average based upon the first three years of high school is included among the predictive measures.

Criterion To Be Predicted. The criterion is the final grade (an average of two semesters) in the senior year in the General Clerical Option of the Business and Office Education Program. The letter grades were coded in terms of a common scale, i.e., A = 4, B = 3, C = 2, D = 1, and F = 0.

Multiple Regression Analysis. The main purpose of the procedure is to develop an equation to assess the importance or weight of each of a number of variables in contributing to the prediction of a criterion of performance (Ferguson, 1966).

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The purpose of the study was to determine the extent to which a selected group of variables predicted the performance of senior high school students who were enrolled in the General Clerical Option of the Business and Office Education Program at two area vocational-technical schools in Oklahoma.

The term clerical in the title of the General Clerical Option needs clarification. The term is used frequently to refer to the entire range of office skills taken as a whole or individually. The term clerk may refer to one who does everything in an office such as filing, checking, arithmetical computations, typewriting, etc. Gekoski (1964) likes to refer to the multi-activitied position as that of general clerk, while the term clerical activity is employed as a generic term to refer to any one, two or several of the specific activities comprising general clerical work. General clerical ability is basically a composite of many specific clerical skills.

Since the General Clerical Option is being investigated it may be wise to point out again that it provides training primarily in advanced typewriting, filing, business and computational machines, duplicating, recordkeeping, and written and oral communication. The research reviewed covered to a large extent the functions mentioned above. Due

to the wide spectrum of activities subsumed under the heading of general clerical work, certain closely related job functions were examined in relation to various criteria of performance.

The first portion of the review was concerned with an extensive compilation of results dealing with clerical occupations prepared by Ghiselli (1966). The second part covered similar research involving the General Aptitude Test Battery (GATB) carried out by the United States Employment Service (1962, 1970). The third part reviews other general clerical validation studies. The fourth part reports the findings of selected validation studies based upon the GATB in other vocational-technical areas.

Findings Reported by Ghiselli

Perhaps the most ambitious review of the validity of occupational aptitude tests prepared to date was that published by Ghiselli (1966). The publication attempted to present in condensed form the results of the many studies which have been conducted on the validity of tests in the selection and placement of workers in various occupations. The published professional literature was searched from 1919 to 1964. To the data obtained from these studies were added a number of results of unpublished studies from a variety of sources in business, industrial, and governmental organizations.

The review was limited to aptitude tests. Studies involving adults were reviewed, and the individuals either were being trained for or employed on some specific job in a business, industrial, or governmental organization. The validity coefficients obtained by correlating aptitude measures against (1) training criteria, and (2) proficiency criteria were reported separately.

In Ghiselli's review he presented trends in validity for jobs classified in accordance with a classification of occupations which he developed (the General Occupational Classification System), and in terms of the classification presented in the Dictionary of Occupational Titles (DOT). For each job the average validity coefficients were presented separately for training and for proficiency criteria, together with the numbers of cases entering into each average. The data presented by Ghiselli reported in terms of the Dictionary of Occupational Titles classification have been utilized in this review since that system breaks down jobs into finer classes than does the General Occupational Classification System.

Since Ghiselli found that the tests employed in the studies were varied in nature and content he classified them into particular groups for convenient review. The tests were strictly aptitude in design and consisted of the sort commonly used in employee selection and placement. The studies included did not involve research utilizing the measures of the General Aptitude Test Battery.

The validities of the tests were examined in terms of two broad categories: training and proficiency criteria. Examples of training criteria employed were grades in occupational training courses, the passing or failing of such courses, and the ratings of learners by instructors. Proficiency criteria were represented by supervisors' ratings of workers' job performance, number of units produced, accident rates, etc. The thrust of this study tended to be concerned with the investigation of test validity against a training criterion. For completeness of reporting, however, Table XXV contained validity coefficients based on both types of criteria when such data were available.

The interesting feature that was apparent was the tendency for correlation coefficients obtained for the training criteria to be higher on the whole than those for the proficiency criteria. In most cases where the prediction of training criteria was investigated, the tests were administered before the workers began training. It appears that the grades and ratings in the courses were well defined estimates of the trainees' performances, and that the tests utilized were relatively good assessments of the abilities demanded to meet the requirements of the courses. Stated another way, in addition to adequate predictors, the criteria tended to be reliable and valid assessments of the trainees' performance.

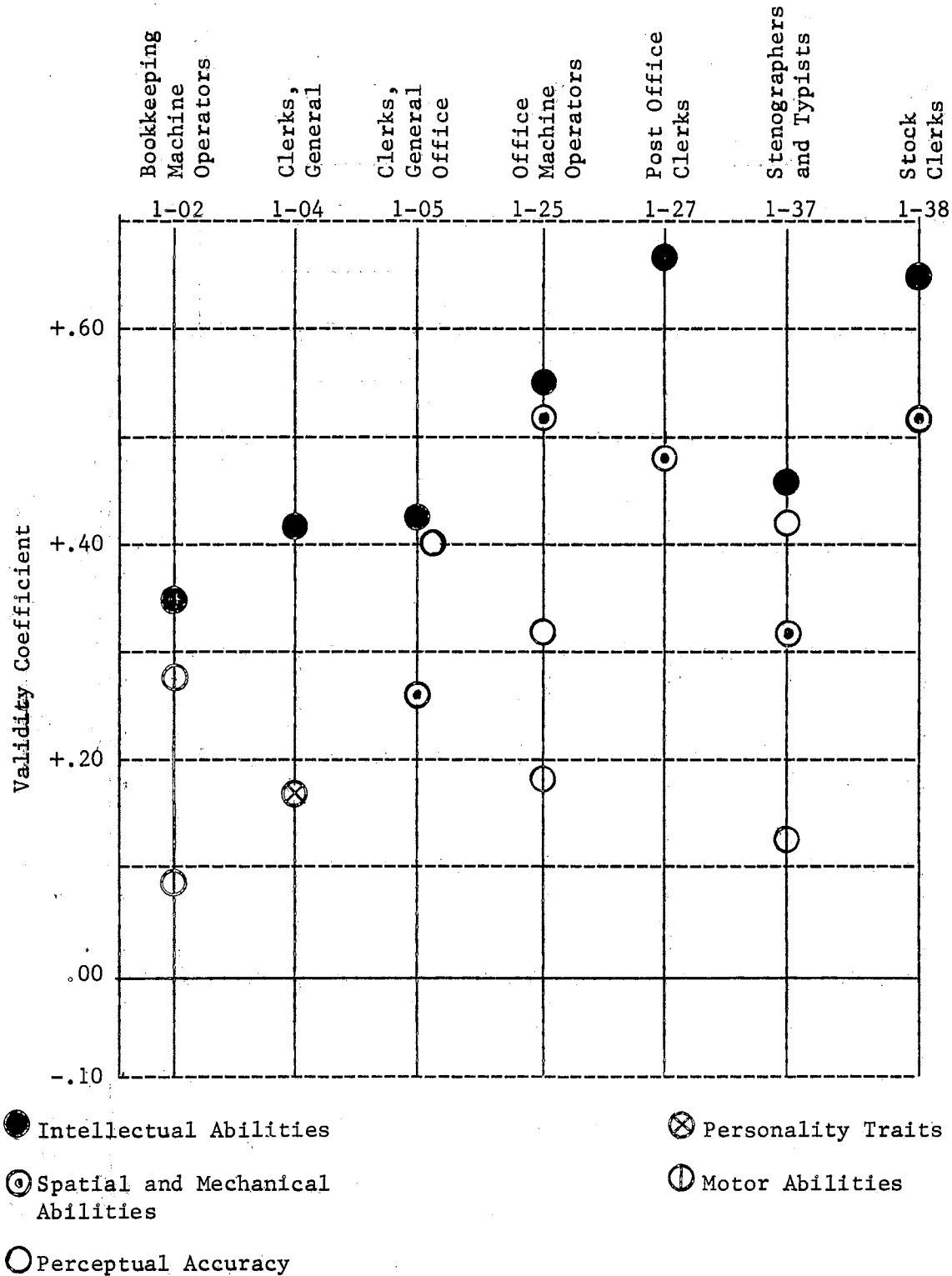
Table I presents a general summary of the validity coefficients for training criteria for clerical occupations. It should be noted that of the average validity coefficients above .30, fifty per cent were based upon measures of intellectual ability, twenty-nine per cent on measures of form perception, and twenty-one per cent on measures of perceptual accuracy. There appeared to be good reason to assume that these capacities were required for acceptable performance in training programs initiated for the purpose of developing clerical skills. The research with the GATB has supported those assumptions to a large extent.

Findings Based on the GATB Research

In order to secure up-to-date information on validity studies utilizing the GATB Manual entitled Section III: Development (1970) was reviewed. The review was concerned with validity data for clerical occupations an individual could prepare for by pursuing the General

TABLE I

SUMMARY OF VALIDITY DATA FOR TRAINING CRITERIA
 REPORTED BY GHISELLI (1966)



Clerical Option or a program like it. Twenty-five pertinent occupations in the clerical field were selected from the manual. In most instances the validity coefficients were based on proficiency criteria.

The technique of multiple cut offs instead of the procedure of multiple correlation was employed in validating GATB data against appropriate criteria (Dvorak, 1956). Even when a crucial ability showed a positive relationship between test scores and success, the method of multiple regression weights permitted the possession of other abilities to compensate for a low amount of the crucial ability. The multiple cut off method did not permit such compensation of some abilities for others required by the job (Dvorak, 1956).

The validity correlations in terms of phi coefficients, along with other data, have been reported in Table XXVI. Cutting scores were presented for those measures which showed the most promising relationships with success.

The validity coefficients ranged from .19 for a validation sample of general office clerks to .71 for a validation sample based on tellers. The median r was .34. One of the three highest phi coefficients was based upon instructors' ratings of students studying bookkeeping. The results of the validation studies in Table XXVI, indicated that the data tended to be in line with the findings based upon the measures reported by Ghiselli which showed that general intelligence, verbal ability, number reasoning, and clerical and form perception are related to the performance of general clerical tasks.

Findings From Validation Studies

Not Reported Above

Dorcus and Jones (1950) summarized a study of 314 general clerical workers in which the criterion correlations between tests and supervisor's ratings were as follows: Immediate Memory .36; Arithmetic .20; Substitution .32; Number Comparison .31; Name Comparison .27. No effort was made to determine the multiple R for the team of tests.

Roe (1956) in evaluating several different studies pointed out that the correlations between clerical tests and intelligence ranged between .35 and .65. She concluded that for adequate performance on the job an I. Q. of at least 90 was needed. A personality inventory administered to 192 clerical workers indicated that the average worker tended to be even-tempered, unwilling to accept responsibility, non-social, lacking in self-sufficiency, and having no great desire to be admired.

Bennett, Seashore, and Wesman (1959) studied the performance of 55 male office employees on the Differential Aptitude Battery. The subjects obtained average percentile scores on Spelling, Sentences, and Abstract Reasoning. The authors analyzed the performance of 265 female general office clerks using the same test battery and concluded no special strengths or weaknesses appeared with which they could be identified.

The technical report (1959) for the Flanagan Aptitude Classification Tests reported that the subtests of the battery important for assessing aptitudes for general office clerk were Tables, Arithmetic, Coding, and Memory. A sample of 275 high school seniors took an early form of the test battery in 1947, and were followed up three to four

years later. Correlations of .44, .25, and .23 were found between Table and Scale Reading, Arithmetic and Memory, and the criterion of rate of salary increased.

Findings of Selected Validation Studies Based Upon
GATB in Other Vocational-Technical Areas

The inclusion of selected validation studies based upon GATB in other vocational-technical areas was considered advisable in order to give a broad picture of the research carried out with this battery. The data have been compiled from GATB Technical Reports issued by the Bureau of Employment Security between 1953 and 1965 and summarized by Loudermilk (1966).

A validity study based upon a sample of 75 students in aviation mechanics in a Detroit vocational high school gave a tetrachoric correlation coefficient of .57 between General Learning Ability, Form Perception, Numerical Aptitude, and the criterion of course grades.

A sample of 56 Minneapolis area vocational school students studying auto body work were administered the GATB as part of the educational program. When Spatial Aptitude, Form Perception, and Manual Dexterity were correlated against the criterion of supervisor's ratings the validity coefficient was .55.

Fifty male auto mechanics trainees in Brooklyn, New York, were tested with the GATB. The tetrachoric correlation between General Learning Ability, Spatial Aptitude, Finger Dexterity, and the criterion of grades received in the course was .61.

Data based on a sample of 52 male employees at eleven service stations in Philadelphia gave a tetrachoric correlation of .72 between

Numerical Aptitude, Finger Dexterity, Manual Dexterity, and the criterion of supervisory ratings.

Sixty-five female trainees in cosmetology in eight beauty schools in Idaho were ranked by instructors on the basis of performance in course work. The tetrachoric correlation was .59 between General Learning Ability, Verbal Aptitude, Form Perception, Finger Dexterity, and the criterion ratings. A cross-validation study based on 34 cosmetology students in Minnesota using the criteria of course grades and instructor's ratings gave a validity coefficient of .63.

A class of 81 Minnesota vocational students studying cabinet making were administered the GATB on admission to the training program. A validity coefficient of .42 was obtained between General Learning Ability, Numerical Aptitude, Spatial Aptitude, Manual Dexterity, and the criterion of instructor's ratings. A cross-validation study undertaken on a sample of 31 male cabinet makers in Nebraska resulted in a validity coefficient of .40.

Fifty-three female students studying in a Washington technical school to be dental assistants were administered the GATB. The phi coefficient between General Learning Ability, Spatial Aptitude, Clerical Perception, and supervisory ratings was .53. A cross-validation study based on 85 California students resulted in a phi coefficient of .21 between the same predictors and supervisory ratings. The validity coefficient shrank substantially when the tests were applied to another sample.

The GATB was administered to 52 draftsmen in the Pennsylvania area. The validity coefficient obtained between General Learning Ability, Numerical Aptitude, Spatial Aptitude, and the criterion of supervisory

ratings was .30. When a cross-validation study was undertaken on subjects in Michigan and Washington the validity coefficient dropped to .23. Such shrinkage tends to occur when the predictors are applied to other samples.

A study conducted on a sample of 53 individuals employed as electrical appliance servicemen in California resulted in a tetrachoric correlation of .53 between General Learning Ability, Numerical Aptitude, Spatial Aptitude, and the criterion of supervisory ratings.

A sample of 50 men employed as electronics technicians in an aircraft corporation in California were given the GATB. The tetrachoric correlation between General Learning Ability, Spatial Aptitude, Form Perception, and supervisory ratings was .68.

The GATB was administered to a sample of 50 male farm mechanics in Nebraska; a phi coefficient of .29 was obtained between General Learning Ability, Spatial Aptitude, Finger Dexterity, and a criterion of supervisory ratings. The validity coefficient was too low to be of any predictive value.

A phi coefficient of .26 was obtained between Verbal Aptitude, Spatial Aptitude, Motor Coordination, and the criterion of supervisory ratings for 80 United States Forest Service employees in California. No attempts were made to cross validate the study.

Research based on 65 male students in a Texas junior college studying to be instrument technicians resulted in a phi coefficient of .26 between General Learning Ability, Numerical Aptitude, Spatial Aptitude, Manual Dexterity, and the criterion of final grade in the course.

Samuelson (1956) studied 13 diesel mechanics in training at the Salt Lake Area Vocational School. He obtained a multiple correlation coefficient of .64 between GATB subtests of General Learning Ability, Finger Dexterity, Clerical Perception, and instructor's ratings. No cross validation of the study was undertaken using a larger number of cases.

The selected studies quoted above indicate that the GATB has been used extensively for validating performance on the battery against criteria of performance in a variety of occupational settings.

Summary

The review summarizes a number of studies involving the use of the GATB and other predictive instruments assessing success in training and on-the-job performance. A selected review of studies concerned with the prediction of success in vocational-technical areas other than the clerical option showed the GATB to be useful for predicting criteria of performance in diverse occupations like auto body work, auto mechanics, service station attendant, cosmetology, cabinet making, dental assistant, drafting, electrical appliance maintenance, electronics, farm equipment mechanics, forestry technician, etc.

Directly pertinent to this investigation are the validity data summarized by Ghiselli and the extensive research based upon the GATB which indicate quite clearly that Intelligence, Verbal Aptitude, Numerical Reasoning, Clerical Perception, and to some extent Form Perception are related to the performance of general clerical tasks. This study utilizes these findings for prediction purposes by combining

measures of these abilities into a battery for assessing performance in a training program referred to as the General Clerical Option.

CHAPTER III

DESIGN AND METHODOLOGY

The investigation is primarily a study concerned with determining the combination of variables which most effectively predict grade point in the General Clerical Option when the data from two area vocational-technical schools are (1) treated separately and (2) in combination.

This section describes the subjects employed, the measuring instruments utilized for assessing student performance, the procedure for obtaining the data, the design of the study, the hypotheses tested, and the statistical methodology for testing the hypotheses.

Subjects

The subjects in the investigation came from two area vocational-technical schools in Oklahoma. The schools which have been designated as Schools A and B furnished the following students for the study.

TABLE II
SAMPLE SIZE AND MEAN AGES OF STUDENTS IN SCHOOLS A AND B

	School A	School B
N	59	66
Mean Age	17-7 months	17-8 months

The two groups consisted completely of females. All of the students were enrolled in the General Clerical Option in the Business and Office Education Program and were classified as seniors in high school.

Measures Employed

The data for the investigation were based upon the following:

1. Grade point average. This measure is the overall grade point average achieved by a student in the first three years of high school; letter grades were coded in terms of a common scale, A = 4 points, B = 3, C = 2, D = 1, and F = 0.
2. The GATB measures (GATB Manual, Section III: Development, 1970). The GATB tests of Three-Dimensional Space, Arithmetic Reasoning, and Vocabulary assess the aptitude referred to as G (Intelligence). Three-Dimensional Space requires the examinee to indicate which one of four drawings of three-dimensional objects can be made from a stimulus figure; the task measures intelligence and spatial aptitude. Arithmetic Reasoning is composed of a number of arithmetic problems expressed verbally; the task measures intelligence and numerical aptitude. Vocabulary consists of a task in which it is required to indicate which two words have either the same or opposite meaning. The coefficient of stability for the three instruments is .89.

The GATB test of Vocabulary which is described above measures V (Verbal Aptitude). The coefficient of stability for this measure is .86.

The GATB tests of Computation and Arithmetic Reasoning assess the behavior labeled N (Numerical Aptitude). Computation

consists of exercises in addition, subtraction, multiplication, or division of whole numbers; the task measures numerical aptitude. The test of Arithmetic Reasoning is described above.

The coefficient of stability for the two measures is .86.

The GATB tests Form Perception and Tool Matching measure an ability called P (Form Perception). The Form Perception Test consists of two groups of variously shaped line drawings; the task is to indicate which figure in the second group is exactly the same size and shape as each figure in the stimulus group. The Tool Matching Test is composed of a stimulus drawing and four black-and-white drawings of single shop tools; the task is to determine which of the four black-and-white drawings is the same as the stimulus drawing. The coefficient of stability for these tests is .74.

The GATB test labeled Name Comparison measures the aptitude called Q (Clerical Perception). The Name Comparison is made up of two columns of names and the task is to inspect each pair of names, one in each column, and indicate whether the names are the same or different. The coefficient of stability for the test is .77.

3. Criterion to be predicted. The criterion is the final grade (an average of two semesters) in the senior year in the General Clerical Option of the Business and Office Education Program.

Procedure

The GATB tests were administered to students in School A during the sophomore year in high school and to students in School B during the junior year. The battery was administered by the staff in the area vocational-technical schools and scored by them. Copies of the test data were made available to the cooperating high schools in which the students were enrolled.

The test and criterion data were punched on cards. The correlation coefficients and regression equations were processed at the Oklahoma State University Computer Center, utilizing a program developed by Goodnight (1972).

Hypotheses Tested

Developers of the GATB indicate that the aptitudes G (Intelligence), V (Verbal Ability), N (Numerical Aptitude), P (Form Perception), and Q (Clerical Perception) were related to the tasks important for the performance of general office work. It was apparent that aptitudes G (Intelligence), V (Verbal Ability), and Q (Clerical Perception) were essential, while the question as to the importance of N (Numerical Aptitude) and P (Form Perception) seemed less clear. The study attempted to determine the importance of aptitudes N and P individually and in combination in conjunction with G, V, Q, and high school grade point average for predicting performance in the General Clerical Option.

The hypotheses tested are:

1. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, P, and Q with the

final grade in the General Clerical Option does not depart significantly from zero.

2. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, N, and Q with the final grade in the General Clerical Option does not depart significantly from zero.
3. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, N, P, and Q with the final grade in the General Clerical Option does not differ significantly from zero.

The .05 level of probability was accepted as the criterion for significance for the zero order r 's; the .01 level of probability was the criterion for significance for the multiple correlation coefficients.

Statistical Methodology

The general method of regression analysis programmed by Goodnight (1972) is similar in basic principle to the technique of multiple regression developed by Doolittle (Peters and Van Voorhis, 1940). The procedure involves the solution of a set of simultaneous equations for the purpose of determining the correlation coefficient between the criterion to be predicted and a team of predictors. The predictors are treated in such a manner that those having high common variance with the criterion tend to have the greater weights. This method seemed more applicable to the problem than the technique of multiple cut offs used for obtaining the validity data described in the GATB Manual (Section III: Development, 1970). This procedure consists of obtaining distributions of data on each test and then determining if the scores

separate the satisfactory from the unsatisfactory workers or trainees. An index of differentiation is computed for each distribution to obtain a suitable cutting score. The method of multiple cut offs does not make it possible to assess how much each of the tests contribute to the variance of the criterion or make it possible to calculate regression weights.

CHAPTER IV

TREATMENT OF RESULTS

Introduction

The purpose of the study is to determine the extent to which a selected group of variables predicted the performance of senior high school students who were enrolled in the General Clerical Option of the Business and Office Education Program at two area vocational-technical schools in Oklahoma.

The analyses of the results are presented in this chapter. The intercorrelations between each of the predictor variables and the correlations of each with the criterion have been given separately for Schools A and B, and for the two schools combined. The technique of multiple correlation has been employed to determine the regression equations which predicted the criterion of performance for subjects in Schools A and B, and in the schools combined.

The technique of multiple regression analysis utilized in the study has been referred to as a general regression procedure. The rationale of the method and the procedures for programming the mathematical operations are given in detail in the User's Guide to the Statistical Analysis System (Goodnight, 1972). The multiple correlation coefficients for each analysis, the regression equations, and other pertinent data for the interpretation of outcomes are presented in this chapter.

The three specific analyses for Schools A and B separately and for the two schools combined consisted of (1) studying the efficiency of GPA, G, V, P, and Q in predicting the criterion; (2) examining the efficiency of predictors GPA, G, V, N, and Q for the same purpose; and (3) assessing the effectiveness of all six of the predictors--GPA, G, V, N, P, and Q, in predicting the criterion of performance. The concern of the investigation centered around the attempt to determine which combination of measures would prove most effective in assessing future performance in the General Clerical Option.

Correlations of Predictors GPA, G, V, P, and Q

Among Themselves and With the Criterion

School A

The data treated consisted of GATB scores, grade point average, and criterion obtained on students who were in the General Clerical Option in the school years 1970-71 and 1971-72. Table III gives the intercorrelations variables required for the multiple regression analysis of data from School A.

The correlation coefficients of all five of the independent variables with the criterion differ significantly from zero at or beyond the .05 level. In addition the relationships are statistically significant between high school grade point average and Intelligence, between high school grade point average and Verbal Aptitude, and between Intelligence and Verbal Aptitude. Further, significant relationships occur between Clerical Perception and Intelligence and between Clerical Perception and Verbal Aptitude. A final finding is the statistically significant association between Verbal Aptitude and Form Perception.

TABLE III
 CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, P,
 AND Q AMONG THEMSELVES AND WITH THE CRITERION
 SCHOOL A
 N=59

	1	2	3	4	5	6
1 Grade Point Average		.42*	.41*	.21	.15	.57*
2 G, Intelligence			.60*	.07	.38*	.51*
3 V, Verbal				.30*	.39*	.53*
4 P, Form Perception					.23	.36*
5 Q, Clerical Perception						.34*
6 Criterion						
Mean	2.80	101.98	100.05	116.08	121.92	3.01
Standard Deviation	.58	11.50	10.36	15.70	12.79	.75

*Significant at or beyond the .05 level.

The ideal situation for the application of multiple regression is one in which the intercorrelations among the predictors are low while the correlations of the predictors with the criterion are substantial (Garrett, 1958). Despite the fact that this situation does not occur here, the obtained multiple R is high enough to be of practical value in predicting the criterion.

The multiple correlation coefficient and the multiple regression equation based upon the data presented in Table III are given in Table IV. The multiple R falls beyond the .01 confidence level which indicates that it differs significantly from zero.

TABLE IV

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL A

Multiple Correlation Coefficient .71*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .463 + .014 + .011 + .010 + .006 - 2.665$$

GPA G V P Q

Standard Error of Estimate of the Criterion Variable $\pm .56$

*Significant beyond the .01 level.

**The grades predicted for the 59 students in School A and actual grades received are presented in Table XXVII, Appendix B.

The five independent variables which were selected (1) correlated significantly in each instance with the criterion, and (2) that the battery as a team correlated with the grade point average high enough that the hypothesis of no significant association could be rejected.

Correlations of Predictors GPA, G, V, P, and Q

Among Themselves and With the Criterion

School B

The data needed to determine the weights of the independent variables for predicting grade point average are presented in Table V. The solution of the simultaneous equations was carried out by means of the general regression procedure outlined in Goodnight (1972). The outcomes are fairly comparable to those obtained on the data from School A. The correlation coefficients of the independent variables with grade point

average ranged from .70 to .30, with all of the values significant beyond the .05 level. The intercorrelations among the predictors reached the same criterion of significance with the exceptions of the correlation between V (Verbal Ability) and P (Form Perception).

TABLE V
CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, P,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOL B
N=66

	1	2	3	4	5	6
1 Grade Point Average		.57*	.61*	.44*	.35*	.70*
2 G, Intelligence			.71*	.48*	.49*	.61*
3 V, Verbal				.19	.36*	.53*
4 P, Form Perception					.57*	.43*
5 Q, Clerical Perception						.30*
6 Criterion						
Mean	2.94	108.68	107.70	119.64	122.89	2.97
Standard Deviation	.56	13.47	12.40	14.62	13.05	.67

*Significant at or beyond the .05 level.

When the regression analysis was undertaken the outcomes are obtained in Table VI. The multiple R of .75 falls beyond the .01 confidence level which indicates that it differs significantly from

zero. As was observed in the case of School A the five independent variables (1) correlated significantly in each instance with the criterion, and (2) the five variables as a team correlated with the criterion to the extent that it could be said that the hypothesis of no relationship was untenable.

TABLE VI

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL B

Multiple Correlation Coefficient .75*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .582 \underset{\text{GPA}}{+} .015 \underset{\text{G}}{+} .002 \underset{\text{V}}{+} .007 \underset{\text{P}}{-} .005 \underset{\text{Q}}{-} .587$$

Standard Error of Estimate of the Criterion Variable $\pm .47$

*Significant beyond the .01 level.

**The grades predicted for the 66 students in School B and actual grades received are presented in Table XXVIII, Appendix B.

The team of the five variables selected for analysis appeared to predict with comparable effectiveness the criterion of performance for the two different vocational-technical schools. The multiple R computed from a sample tends to be somewhat inflated with respect to the population R, owing to the accumulation of chance errors which tend to pile up since R is always positive. Even though a shrinkage formula was utilized to correct for inflation in both multiple correlation coefficients.

(Garrett, 1958) the corrections turned out to be negligible. The obtained R's gave a fairly good measure of the population R.

Correlations of Predictors GPA, G, V, P, and Q
Among Themselves and With the Criterion
Schools A and B Combined

The data were analyzed separately for the two schools. The next step was to combine the data from the two samples. The intercorrelations of the predictors for the two samples combined are presented in Table VII. All of the correlation coefficients fall at or beyond the .05 level of confidence.

In order to obtain the regression weights it was necessary to solve five simultaneous equations. The coefficient of multiple correlation, the weights, and the standard error of estimate for the criterion are presented in Table VIII.

The multiple correlation coefficient was significant beyond the .01 level of confidence. It was high enough to suggest that it was practical to attempt to predict grade point average from the regression weights obtained from the analysis. The multiple correlation coefficients and the standard error of criterion estimates were relatively comparable in magnitude for all three of the regression analyses (Table XXIV).

A concluding statement about the statistical outcomes for the three analyses may be summarized by showing the percentages that each predictor contributed, respectively, to the variance of the criterion. The percentages are shown in Table IX.

In all three of the analyses grade point average and measured intelligence contributed the largest percentages to criterion variance.

Lesser amounts were contributed by the other predictors. Table IX indicates that in the cases of School A and School B the five predictors contributed in each instance to 50 per cent or more of the criterion variance.

TABLE VII
CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, P,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOLS A AND B COMBINED
N=125

	1	2	3	4	5	6
1 Grade Point Average		.52*	.53*	.33*	.26*	.62*
2 G, Intelligence			.69*	.31*	.44*	.53*
3 V, Verbal				.26*	.36*	.48*
4 P, Form Perception					.40*	.39*
5 Q, Clerical Perception						.32*
6 Criterion						
Mean	2.87	105.52	104.09	117.96	122.43	2.99
Standard Deviation	.57	12.97	12.06	15.18	12.88	.71

*Significant at or beyond the .05 level

TABLE VIII

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOLS A AND B COMBINED

Multiple Correlation Coefficient .69*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .522 \text{ GPA} + .011 \text{ G} + .004 \text{ V} + .007 \text{ P} + .002 \text{ Q} - 1.161$$

Standard Error of Estimate of the Criterion Variable $\pm .53$

*Significant beyond the .01 level.

**The grades predicted for the 125 students in Schools A and B combined and the actual grades received are presented in Table XXIX, Appendix B.

Correlations of Predictors GPA, G, V, N, and Q

Among Themselves and With the Criterion

School A

A second regression analysis was undertaken to ascertain the effect upon the multiple R of the substitution of N (Numerical Aptitude) for P (Form Perception) in the regression equation. The zero order product moment coefficients required for the analysis are shown in Table X. All of the criterion correlations fall beyond the .01 level of confidence excepting that of N (Numerical) with the criterion. The correlation of N (Numerical) with the criterion turned out to be larger in the other two analyses, i.e., .62 for School B and .41 for Schools A and B combined.

TABLE IX

THE PROPORTION OF THE VARIANCE OF THE CRITERION
ATTRIBUTABLE TO THE JOINT ACTION OF THE
PREDICTORS GPA, G, V, P, AND Q

SCHOOL A

$$R^2 = .50$$

GPA contributes 20%, G 11%, V 8%, P 7%, Q 4%

SCHOOL B

$$R^2 = .56$$

GPA contributes 34%, G 18%, V 2%, P 5%, Q 3%*

SCHOOLS A AND B COMBINED

$$R^2 = .47$$

GPA contributes 26%, G 11%, V 3%, P 6%, Q 1%

*Since the beta for Q was negative the total percentage of variance accounted for by the battery may be obtained by subtracting the percentage contributed by Q from the total contributed by the other predictors. The resulting percentage equals R^2 .

The multiple R, the regression equation, and the standard error of criterion estimate for School A are presented in Table XI. It should be noted that the multiple R is a little lower than it was when P (Form Perception) was included and N (Numerical) omitted. In the regression equation N (Numerical) takes a negative value. The addition of N (Numerical) and the elimination of P (Form Perception) from the regression equation does not improve the prediction of the criterion in School A (see Table XXIV).

TABLE X
CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOL A
N=59

	1	2	3	4	5	6
1 Grade Point Average		.42*	.41*	.16	.15	.57*
2 G, Intelligence			.60*	.66*	.38*	.51*
3 V, Verbal				.36*	.39*	.53*
4 N, Numerical					.40*	.22
5 Q, Clerical Perception						.34*
6 Criterion						
Mean	2.80	101.98	100.05	107.49	121.92	3.01
Standard Deviation	.58	11.50	10.36	12.89	12.79	.75

*Significant at or beyond the .05 level.

Correlations of Predictors GPA, G, V, N, and Q

Among Themselves and With the Criterion

School B

The regression analysis for School B in which N (Numerical Aptitude) was substituted for P (Form Perception) was based upon the data reported in Table XII. The correlation coefficient obtained between N (Numerical) and the criterion is quite substantial compared to that obtained in School A. The students in School B appeared to be a little less

variable in performance on the measure of N (Numerical Aptitude) than was true of the students in School A.

TABLE XI

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL A

Multiple Correlation Coefficient	.69*
Multiple Regression Equation:	
Y(criterion)** =	.481 + .107 + .015 - .009 + .010 - 1.843
	GPA G V N Q
Standard Error of Estimate of the Criterion Variable	±.57

*Significant beyond the .01 level.

**The grades predicted for the 59 students in School A and actual grades received are presented in Table XXX, Appendix C.

The results of the regression analysis for the students in School B are shown in Table XIII.

The multiple R is significant beyond the .01 confidence level. The standard error of estimate of the criterion is smaller than the one obtained for School B in which the regression analysis was based upon GPA, G, V, P, and Q (Table XXIV).

TABLE XII
 CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N,
 AND Q AMONG THEMSELVES AND WITH THE CRITERION
 SCHOOL B
 N=66

	1	2	3	4	5	6
1 Grade Point Average		.57*	.61*	.51*	.35*	.70*
2 G, Intelligence			.71*	.71*	.49*	.61*
3 V, Verbal				.37*	.36*	.53*
4 N, Numerical					.60*	.62*
5 Q, Clerical Perception						.30*
6 Criterion						
Mean	2.94	108.68	107.70	107.96	122.89	2.97
Standard Deviation	.56	13.48	12.40	11.75	13.05	.67

*Significant at or beyond the .05 level.

Correlations of Predictors GPA, G, V, N, and Q
 Among Themselves and With the Criterion
 Schools A and B Combined

In order to develop the regression equation from the data for Schools A and B combined the correlations shown in Table XIV had to be determined. All of the correlation coefficients are significant at or beyond the .05 level. The correlation between N (Numerical) and the criterion (grades in course) tends to fall between the values

obtained for Schools A and B, which would be effected as a consequence of the combining of the data for the two schools.

TABLE XIII

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL B

Multiple Correlation Coefficient .78*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .515 + .003 + .007 + .024 - .009 - 1.074$$

GPA G V N Q

Standard Error of Estimate of the Criterion Variable $\pm .44$

*Significant beyond the .01 level.

**The grades predicted for the 66 students in School B and actual grades received are presented in Table XXXI, Appendix C.

The multiple correlation coefficient and the other outcomes of the regression analysis are shown in Table XV. None of the predictors in the regression equation have negative weights.

The multiple R for the schools combined when N (Numerical) was included and P (Form Perception) excluded was .68. When N (Numerical) was excluded and P (Form Perception) included the multiple R was .69.

The percentages that each of the predictors contributed to the variance of the criterion are presented in Table XVI. As in the case of the analysis including P (Form Perception) and excluding N (Numerical) the high school grade point average contributed more to criterion

variance than did any of the other measures individually. In the case of School B the five predictors contributed to more than 60 per cent of the variance criterion.

TABLE XIV

CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOLS A AND B COMBINED
N=125

	1	2	3	4	5	6
1 Grade Point Average		.52*	.52*	.34*	.26*	.62*
2 G, Intelligence			.69*	.66*	.44*	.53*
3 V, Verbal				.35*	.36*	.48*
4 N, Numerical					.50*	.41*
5 Q, Clerical Perception						.32*
6 Criterion						
Mean	2.87	105.52	104.09	107.74	122.43	2.99
Standard Deviation	.57	12.97	12.06	12.25	12.88	.71

*Significant at or beyond the .05 level.

TABLE XV

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION
EQUATION, AND THE STANDARD ERROR OF ESTIMATE
OF THE CRITERION VARIABLE FOR
SCHOOLS A AND B COMBINED

Multiple Correlation Coefficient .68*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .558 + .007 + .006 + .006 + .003 - 1.016$$

GPA G V N Q

Standard Error of Estimate of the Criterion Variable $\pm .53$

*Significant beyond the .01 level.

**The grades predicted for the 125 students in School A and B combined and the actual grades received are presented in Table XXXII, Appendix C.

Correlations of Predictors GPA, G, V, N, P, and Q

Among Themselves and With the Criterion

School A

In order to determine if the prediction of the criterion could be improved by utilizing both N (Numerical) and P (Form Perception) the third general step in the analysis consisted of including both measures, along with the others, in the battery of predictors in determining the regression weights. The zero order r's employed in developing the regression equation for School A are given in Table XVII. All but one of the criterion correlations differed significantly from zero. The correlation of N (Numerical) with the criterion was low

which is out of line with the other validity coefficients obtained for School B and Schools A and B combined.

TABLE XVI

THE PROPORTION OF THE VARIANCE OF THE CRITERION
ATTRIBUTABLE TO THE JOINT ACTION OF THE
PREDICTORS GPA, G, V, N, AND Q

SCHOOL A

$$R^2 = .47$$

GPA contributes 21%, G 13%, V 11%, N 3%*, Q 6%

SCHOOL B

$$R^2 = .61$$

GPA contributes 30%, G 4%, V 7%, N 25%, Q 5%*

SCHOOLS A AND B COMBINED

$$R^2 = .46$$

GPA contributes 28%, G 7%, V 5%, N 4%, Q 2%

*Since the beta is negative the total percentage of variance accounted for by the battery may be obtained by subtracting the percentage contributed by the negative value from the total contributed by the other predictors. The resulting percentage equals R^2 .

The multiple R and the regression weights obtained when the battery of six predictors was analyzed are given in Table XVIII.

TABLE XVII

CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N, P,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOL A
N=59

	1	2	3	4	5	6	7
1 Grade Point Average		.42*	.41*	.16	.21	.15	.57*
2 G, Intelligence			.60*	.66*	.07	.38*	.51*
3 V, Verbal				.36*	.30*	.39*	.53*
4 N, Numerical					.22	.40*	.22
5 P, Form Perception						.23	.36*
6 Q, Clerical Perception							.34*
7 Criterion							
Mean	2.80	101.98	100.05	107.49	116.08	121.92	3.01
Standard Deviation	.58	11.50	10.36	12.89	15.70	12.79	.75

*Significant at or beyond the .05 level.

The multiple R for School A with N (Numerical) excluded is of the precise magnitude when N is included in the prediction battery. As for as School A is concerned adding this variable does not improve the prediction of grade point average in the General Clerical Option.

TABLE XVIII

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL A

Multiple Correlation Coefficient .71*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .458 \text{ GPA} + .016 \text{ G} + .001 \text{ V} - .003 \text{ N} + .009 \text{ P} + .007 \text{ Q} - 2.536$$

Standard Error of Estimate of the Criterion Variable $\pm .56$

*Significant beyond the .01 level.

**The grades predicted for the 59 students in School A and actual grades received are presented in Table XXXIII, Appendix D.

Correlations of Predictors GPA, G, V, N, P, and

Q Among Themselves and With the Criterion

School B

To determine the appropriate regression weights for predicting grades in the General Clerical Option in School B the zero order r 's in Table XIX had to be obtained. All but one of the zero order correlation coefficients departed significantly from zero. With the exception of one criterion value all were of the magnitude of .30 or better.

The multiple correlation coefficient and the regression weights based upon the r 's are shown in Table XX. The multiple correlation coefficient obtained for School B using the six predictors was the highest of any obtained in the analysis (Table XX). The multiple R for School B when P (Form Perception) was included and N (Numerical)

excluded was .75; when P (Form Perception) was excluded and N (Numerical) included the multiple R was .78.

TABLE XIX

CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N, P,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOL B
N=66

	1	2	3	4	5	6	7
1 Grade Point Average		.57*	.61*	.51*	.44*	.35*	.70*
2 G, Intelligence			.71*	.71*	.48*	.49*	.61*
3 V, Verbal				.37*	.19	.36*	.53*
4 N, Numerical					.42*	.60*	.62*
5 P, Form Perception						.57*	.43*
6 Q, Clerical Perception							.30*
7 Criterion							
Mean	2.94	108.68	107.70	107.95	119.64	122.89	2.97
Standard Deviation	.56	13.47	12.40	11.75	14.62	13.05	.67

*Significant at or beyond the .05 level.

TABLE XX

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOL B

Multiple Correlation Coefficient .80*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .395 \underset{\text{GPA}}{-} .005 \underset{\text{G}}{+} .015 \underset{\text{V}}{+} .028 \underset{\text{N}}{+} .011 \underset{\text{P}}{-} .016 \underset{\text{Q}}{-} 1.735$$

Standard Error of Estimate of the Criterion Variable $\pm .43$

*Significant beyond the .01 level.

**The grades predicted for the 66 students in School B and actual grades received are presented in Table XXIV, Appendix D.

Correlations of Predictors GPA, G, V, N, P, and
Q Among Themselves and With the Criterion
Schools A and B Combined

The correlation coefficients utilized in computing the multiple R and the regression weights for predicting performance in Schools A and B combined are given in Table XXI. All of the criterion coefficients departed significantly from zero.

The multiple correlation coefficient and the other critical data are shown in Table XXII. The addition of both N (Numerical) and P (Form Perception) to the prediction battery does little to improve its efficiency over the battery in which one or the other was included separately.

TABLE XXI

CORRELATIONS OF THE INDEPENDENT VARIABLES GPA, G, V, N, P,
AND Q AMONG THEMSELVES AND WITH THE CRITERION
SCHOOLS A AND B COMBINED
N=125

	1	2	3	4	5	6	7
1 Grade Point Average		.52*	.52*	.34*	.33*	.26*	.62*
2 G, Intelligence			.69*	.66*	.31*	.44*	.53*
3 V, Verbal				.35*	.26*	.36*	.48*
4 N, Numerical					.09	.50*	.41*
5 P, Form Perception						.40*	.39*
6 Q, Clerical Perception							.32*
7 Criterion							
Mean	2.87	105.52	104.09	107.74	117.96	122.43	2.99
Standard Deviation	.57	12.97	12.06	12.25	15.18	12.88	.71

*Significant at or beyond the .05 level.

The percentages that each predictor contributed to the variance of the criterion are shown in Table XXIII.

P (Form Perception) contributes approximately the same amount to the variance of the criterion in all three samples. This is not true of N (Numerical) where in the case of School B it contributes as much as 31 per cent to criterion variance, while it contributes no more than one per cent in School A. An examination of the tables of zero order r 's for Schools A and B combined in which the six predictors were included shows that the correlations between N (Numerical) and the

criterion tend to vary from .22 for School A to .62 for School B. The criterion r's for P (Form Perception) appear to be more stable ranging from .36 for School A to .43 for School B.

TABLE XXII

THE MULTIPLE CORRELATION COEFFICIENT, THE REGRESSION EQUATION, AND THE STANDARD ERROR OF ESTIMATE OF THE CRITERION VARIABLE FOR SCHOOLS A AND B COMBINED

Multiple Correlation Coefficient .70*

Multiple Regression Equation:

$$Y(\text{criterion})^{**} = .501_{\text{GPA}} + .004_{\text{G}} + .007_{\text{V}} + .011_{\text{N}} + .009_{\text{P}} - .002_{\text{Q}} - 1.584$$

Standard Error of Estimate of the Criterion Variable $\pm .52$

*Significant Beyond the .01 level.

**The grades predicted for the 125 students in Schools A and B combined and the actual grades are presented in Table XXXV, Appendix D.

Summary Comment

The multiple correlation coefficients and the standard errors of criterion estimate for the nine regression analyses are presented in Table XXIV. When the six predictors (Part C in Table XXIV) are employed the multiple correlation coefficients tend to be higher than the multiple correlation coefficients based upon the variables in A and B. The differences are small, however, and for prediction purposes add little in addition that is practical for the use of the counselor.

TABLE XXIII

THE PROPORTION OF THE VARIANCE OF THE CRITERION
ATTRIBUTABLE TO THE JOINT ACTION OF THE
PREDICTORS GPA, G, V, N, P, AND Q

SCHOOL A

$$R^2 = .50$$

GPA contributes 20%, G 12%, V 8%, N 1%*, P 7%, Q 4%

SCHOOL B

$$R^2 = .63$$

GPA contributes 23%, G 6%*, V 15%, N 31%, P 10%, Q 9%*

SCHOOLS AND B COMBINED

$$R^2 = .49$$

GPA contributes 25%, G 4%, V 6%, N 8%, P 7%, Q 1%*

*Since the beta is negative the total percentage of variance accounted for by the battery may be obtained by subtracting the percentage contributed by the negative value from the total contributed by the other predictors. The resulting percentage equals R^2 .

TABLE XXIV
 MULTIPLE R'S AND STANDARD ERRORS OF CRITERION
 FOR THE NINE REGRESSION ANALYSES

	R	SE _c
A. Analysis Based Upon GPA, G, V, P, and Q		
School A	.71*	.56
School B	.75*	.47
Schools A and B Combined	.69*	.53
B. Analysis Based Upon GPA, G, V, N, and Q		
School A	.69*	.57
School B	.78*	.44
Schools A and B Combined	.68*	.53
C. Analysis Based Upon GPA, G, V, N, P, and Q		
School A	.71*	.56
School B	.80*	.43
Schools A and B Combined	.70*	.52

*Significant beyond the .01 level.

CHAPTER V

OUTCOMES, CONCLUSIONS, RECOMMENDATIONS, AND SUMMARY STATEMENT

Outcomes Based on the Testing of the Null Hypotheses

The main purpose of the investigation was to determine the variables which predicted the performance of senior high school students who were enrolled in the General Clerical Option of the Business and Office Education Program at two area vocational-technical schools in Oklahoma. The variables selected were overall grade point average in high school and five of the tests of the GATB. The criterion was the average grade of the two semesters in the General Clerical Option. The study was limited to classes held at the two centers in the school years 1970-71 and 1971-72.

The technique of multiple correlation was employed as the statistical procedure to determine the weights each of the measures contributed to the prediction of the criterion. The predictors were selected on the basis of research reported in the literature.

The technique of multiple correlation was utilized to test the following null hypotheses:

1. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, P, and Q with the final grade

- in the General Clerical Option did not depart significantly from zero.
2. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, N, and Q with the final grade in the General Clerical Option did not depart significantly from zero.
 3. In Schools A and B and in Schools A and B combined the association of the predictors GPA, G, V, N, P, and Q with the final grade in the General Clerical Option did not differ significantly from zero.

The null hypotheses had to be rejected in all instances (Table XXIV). The correlation coefficients were significant beyond the .01 level. The statistical evidence indicated clearly that the three different combinations of predictors were approximately equivalent in the effectiveness with which they were able to predict earned grade point average in the General Clerical Option.

Conclusions

The following conclusions may be drawn as a consequence of the outcomes of this research.

1. The predictors employed for assessing level of performance in the General Clerical Option are useful for this purpose.
2. The predictors GPA, G, V, N, P, and Q seem to do a better job than the other combinations of the predictors investigated.
3. From the stand point of stability the findings are similar so that the regression equations can be employed with confidence

in assessing the performance of comparable individuals other than the ones on which the weights were determined.

4. The outcomes of the analyses are positive and stable enough so that they can be employed by counselors and teachers in conjunction with other data in assisting students to make realistic assessments of the abilities demanded by the program.
5. It needs to be stressed that the predicted grade point average is useful in getting an estimate of the level of performance to be expected from the student, but that factors, like drive, attitude toward school work, estimates of goals to be achieved, etc., are not part of the statistical assessment and must be determined in other ways by the counselor or teacher.

Recommendations

The findings of the investigation make it possible to recommend the following suggestions for further consideration:

1. The regression analysis based upon predictors GPA, G, V, N, P, and Q should be developed at other area vocational-technical schools in the state for the purpose of obtaining appropriate regression weights for predicting performance in the General Clerical Option at those schools.
2. The regression weights should be used to assess the abilities of those applicants who wish subsequently to enter the General Clerical Option.
3. The regression weights for the variables that predicted the criterion should be employed by the counselors in conjunction with evidence based upon stated or measured interests,

motivation as exhibited in class or in extra curricular responsibilities, stable temperamental characteristics, and certain physical qualifications such as good eyesight.

4. An example of the application of the regression equation can be illustrated by taking the following results from data obtained on Mary Morey Doe in School A. The generation of data was accomplished via the following equation from Table IV:

$$Y = .463_{\text{GPA}} + .014_{\text{G}} + .011_{\text{V}} + .010_{\text{P}} + .006_{\text{Q}} - 2.665$$

The data obtained for Mary M. Doe were as follows on the measures listed below: grade point average 2.70, G (Intelligence) 102, V (Verbal Ability) 95, P (Form Perception) 102, and Q (Clerical Perception) 98. The overall grade point average, G, V, P, and Q were given variables, and the standard error (S.E.) was calculated via the formula .56 (Table IV) x 1.96, the T Table value. The procedure for obtaining the predicted criterion grade is to multiply the regression weights by the appropriate results for each measure.

$$\begin{aligned} \text{Predicted GPA} &= (.463_{\text{GPA}} \times 2.70) + (.014_{\text{G}} \times 102) + (.011_{\text{V}} \times 95) \\ &\quad + (.010_{\text{P}} \times 102) + (.006_{\text{Q}} \times 98) - 2.665 = \\ &2.67 \pm \text{S.E. (1.10)} \end{aligned}$$

The true criterion value 2.67 falls within the limits 1.57 and 3.77 ninety-five chances in one hundred. It must be emphasized again that the counselor or teacher should use the predicted criterion score in conjunction with other information about the student.

5. A potentially helpful procedure would be to look at the students whose predicted grade point average in the General Clerical Option fell below a value of 2.50 in order to determine their weaknesses and special needs so that they could receive appropriate assistance early in their training experience.
6. The method employed in the study could be replicated in other schools in other states for the purpose of developing certain general counseling and selection procedures which could be applicable in area vocational-technical schools in a broad geographic area.

Summary Statement

The method of general regression was employed in this study for the purpose of predicting the degree of success to be achieved by the student. By this method the grade point average for each student can be predicted within the limits of the standard error of measurement. Such precision cannot be attained by the method of multiple cut offs which was employed in obtaining the validity data reported in the GATB Manual (Section III: Development, 1970).

The regression weights obtained in the analyses reported in the study can be used by the counselor or teacher to assess fairly precisely the level of performance to be achieved by the student in the General Clerical Option.

Again it should be stressed that predicted grade point average is not to be used alone without other counseling resources. The tendency may appear, at times, to stress test scores at the expense of other data in predicting future school achievement. This type of one-sided

emphasis needs to be avoided because other factors that influence the student's behavior should not be neglected.

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APPENDIX A

TABLE XXV
 VALIDITY COEFFICIENTS FOR CLERICAL AND RELATED
 OCCUPATIONS REPORTED BY GHISELLI (1966)
 1-01 to -49 (DOT)

	Bookkeepers and Cashiers 1-01		Bookkeeping Machine Operators 1-02		Checkers 1-03	Clerks, General 1-04		Clerks, General Office 1-05	
	Train.	Prof.	Train.	Prof.	Prof.	Train.	Prof.	Train.	Prof.
Intellectual Abilities	.37a	.22d	.35b	.21d	.54a	.41b	.20d	.42f	.41e
Intelligence	.37a	.22c	.28b	.24c	.54a	.32a	.08b	.42f	.43d
Immediate Memory		.25b	.46a	.06b					.34b
Substitution		.13b	.44a	.03b			.19d	.21b	.35c
Arithmetic		.24b	.35a	.26b	.50a	.50a	.22d	.43e	.37d
Spatial and Mechanical Abilities		.15a		.34b			.04a	.25e	.02a
Spatial Relations				.31b				.27d	.07a
Location		.15a		.37b			.04a		-.01a
Mechanical Principles							.24e		
Perceptual Accuracy		.24d	.28b	.31d	.23a	.48a	.24d	.41b	.25d
Number Comparison		.21b	.36a	.34c		.48a	.24d	.42a	.24c
Name Comparison		.35b	.19a	.35c				.41b	.26d
Cancellation		.23b		-.03b	.23a				.20b
Pursuit									-.29a
Perceptual Speed				.46b					
Motor Abilities		.21b	.09b	-.01c					.18d
Tracing						.34a			-.10a
Tapping		.24b	.01a	.11b					-.28a
Dotting		.19b	.16a	-.04b		.34a			-.07a
Finger Dexterity				-.11b					.28b
Hand Dexterity				-.05a					.13b
Arm Dexterity				.34a					.14b
Personality Traits		.21b			.21b	.17d	.20a		.37b
Personality		.19b			.21b		.20a		.37b
Interest		.22b				.17d			

TABLE XXV (CONTINUED)

	Post Office Clerks 1-27		Stenographers and Typists 1-37		Stock Clerks 1-38		Telegraph phone Oper. 1-42 1-42		Clerks & Rel. Occup. 1-49
	Train.	Prof.	Train.	Prof.	Train.	Prof.	Prof.	Prof.	Prof.
Intellectual Abilities	.66d	.18b	.48f	.28e	.65d	.31d	.26b	.25b	.33b
Intelligence	.63c	.20b	.56d	.28d	.64d	.34b	.12a	.27b	.33b
Immediate Memory			.32b	.40b					
Substitution			.24c	.20b		.13a	.32a		
Arithmetic	.69c	.17b	.49f	.27d	.69d	.30c	.29a	.23b	
Spatial and Mechanical Abilities	.49d	.13b	.31f	.21d	.52d	.32b	.21a		
Spatial Relations	.52c	.11b	.32e	.22c	.53d	.32b	.22a		
Location			.25c	.20b			.20a		
Mechanical Principles	.46c	.15b	.28f	.21d	.50d				
Perceptual Accuracy			.42e	.30d		.34a	.13a	.23b	.10a
Number Comparison			.31b	.30c		.34a	.13a	.23b	
Name Comparison			.36b	.32b					
Cancellation			.59b	.28b					.10a
Pursuit			.22b						
Perceptual Speed			.43e						
Motor Abilities			.13d	.20b			.20b		
Tracing			.16b				.20a		
Tapping			.24b	.15a			.16a		
Dotting			.11b	.19a			.20a		
Finger Dexterity			.07c	.26b			.21b		
Hand Dexterity			.30a	.16a					
Arm Dexterity			.09a	-.09a					
Personality Traits				.10b					.10a
Personality				.15b					.10a
Interest				-.01b					

TABLE XXV (CONTINUED)

	Finan. Instit. Clerks 1-05	Insur- ance Clerks 1-08	Clerks in Trade 1-12	File Clerks 1-17	1-18	Office Machine Operators 1-25	Paymasters Payroll Clerks Timekeepers 1-26	
	Train.	Prof.	Prof.	Prof.	Prof.	Train.	Prof.	Prof.
Intellectual Abilities	.07a	.32d	.27b	.18c	.30b	.55d	.23d	.25a
Intelligence	.07a	.37b	.27a	.32b	.01a	.52d	.21d	
Immediate Memory		.15b		-.22a	.37b		.35c	.14a
Substitution		.42a		-.10b	.22a	.22a	.29c	
Arithmetic		.31c	.26a	.22b	.45a	.60d	.25d	.36a
Spatial and Mechanical Abilities				-.05b	.05b	.52d	.18d	
Spatial Relations				.07a	.01a	.55c	.15c	
Location				-.11b	.10a	.49a	.17c	
Mechanical Principles						.50c	.30b	
Perceptual Accuracy		.45b	.26a	-.12b	.20b	.32c	.26d	.22a
Number Comparison		.38b	.26a	.00b	.23b	.35b	.31d	.21a
Name Comparison		.41b		-.47a	.16a		.33c	.22a
Cancellation				.02a		.11a	.20d	
Pursuit				-.26a	.25a		.19b	
Perceptual Speed		.59a			.06a	.31c	.31b	
Motor Abilities		.22a		-.14b	.28b	.18b	.17d	
Tracing		.22a		-.09a	.21a	.08a	.21b	
Tapping				-.28a	.15a	.24b	.16b	
Dotting				-.05a	.33b		.15c	
Finger Dexterity					.41a		.18b	
Hand Dexterity							.21a	
Arm Dexterity							.20a	
Personality Traits		.33b					.19b	
Personality							.19b	
Interest		.33b						

a. Less than 100 cases
b. 100 to 499 cases

c. 500 to 999 cases
d. 1,000 to 4,999 cases

e. 5,000 to 9,999 cases
f. 10,000 or more cases

TABLE XXVI

GATB VALIDATION DATA FOR SELECTED CLERICAL OCCUPATIONS

Occupation and Code	Sample	N	Date of Study	Criterion	GATB Norms	Type of Validity
Audit Clerk, 210.388	Employees	53	1960	Supervisory ratings	Q-105, K-100, F-80	.50 Conc.
Bookkeeper I, 210.388	Students	66	1958	Instructors' ratings	G-90, V-95, N-95	.49 Conc.
Calculating-Machine Operators, 216.488	Employees	53	1955	Supervisory ratings	N-95, P-100, Q-105, K-95	.40 Conc.
Clerical Occupations, Selected, Checker II, 209.688 IBM Coder, 219.388 Inserter, 230.887 Letter-Opener Operator, 231.588 Mail Clerk, 231.588 Sorter, 209.688	Employees	66	1951	Supervisory ratings	Q-100, K-100	.39 Conc.
Clerk, General Office, 219.388	Validation Sample: Employees	198	1957	Supervisory ratings	G-95, V-90, N-90, Q-110	.19 Conc.
	Cross Validation Sample: Employees	103	1961	Supervisory ratings	G-95, V-90, N-90, Q-110	.30 Conc.
Coding Clerk, 219.388	Employees	64	1967	Supervisory ratings	V-95, Q-95, K-90	.29 Conc.
Copy Holder, 209.588	Employees	105	1957	Work sample scores and supervisory ratings	G-85, V-100, P-95, Q-100	.35 Conc.
Proofreader I, 209.688						
File Clerk II, 206.388	Applicants	58	1950	Supervisory ratings	G-95, Q-95	.68 Pred.
Key-Punch Operator, 213.582	Employees	193	1960	Supervisory ratings	G-85, N-85, Q-90, F-95	.34 Conc.
Room Clerk, 242.368	Employees	54	1964	Supervisory ratings	G-95, N-100, Q-100	.32 Conc.
Hotel Clerk, 242.368						
Stenographer, 202.388	Validation Sample: Students	130	1949	Work sample	G-95, P-100, Q-100, K-100	.20 Conc.
Typist, 203.588	Cross Validation Sample I: Students	60	1951	Work sample	G-95, P-100, Q-100, K-100	.44 Conc.
Clerk-Typist, 209.388	Cross Validation Sample II: Students	50	1951	Work sample	G-95, P-100, Q-100, K-100	.35 Conc.
	Cross Validation Sample III: Students	58	1951	Work sample	G-95, P-100, Q-100, K-100	.28 Conc.
	Cross Validation Sample IV: Employees	51	1967	Supervisory ratings	G-95, P-100, Q-100, K-100	.21 Conc.
	Cross Validation Sample V: Students	51	1966	Grade-point averages	G-95, P-100, Q-100, K-100	.34 Pred.
Tabulating-Machine Operators 213.782	Employees	203	1953	Supervisory ratings	G-95, N-95, S-85, Q-100	.24 Conc.
Telephone Ad-Taker, 249.368	Employees	60	1963	Supervisory ratings	G-90, Q-90, K-100	.27 Conc.
Telephone-Answering-Service Operator, 235.862						
Teller, 212.363	Validation Sample: Employees	50	1962	Supervisory ratings	G-90, Q-105, F-100	.71 Conc.
	Cross Validation Sample: Employees	50	1961	Supervisory ratings	G-90, Q-105, F-100	.25 Conc.
Ward Clerk, 219.388	Employees	50	1960	Supervisory ratings	G-80, V-100, Q-90	.38 Conc.

APPENDIX B

TABLE XXVII
 OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS
 IN SCHOOL A

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.75	.25
2	1.00	2.44	-1.44
3	3.50	3.30	.20
4	3.50	2.58	.92
5	4.00	3.77	.24
6	2.00	2.14	-.14
7	4.00	2.98	1.03
8	2.00	2.64	-.64
9	2.00	2.20	-.20
10	4.00	3.17	.84
11	2.00	2.24	-.24
12	3.50	3.14	.37
13	2.00	3.05	-1.05
14	3.00	3.76	-.76
15	4.00	3.68	.33
16	3.00	2.79	.22
17	2.00	2.68	-.68
18	3.00	2.80	.21
19	4.00	3.61	.40
20	3.00	2.95	.06
21	4.00	3.23	.77
22	1.00	1.56	-.56
23	3.00	2.95	.06
24	3.00	3.31	-.31
25	4.00	3.92	.09
26	4.00	3.80	.21
27	3.50	2.87	.64
28	3.00	3.34	-.34
29	2.00	2.05	-.05
30	3.50	3.63	-.13
31	2.50	2.97	-.47
32	2.50	3.06	-.56
33	3.50	2.76	.75
34	2.50	2.42	.09
35	2.00	3.44	-1.44
36	3.50	3.35	.16
37	3.50	3.46	.05
38	3.50	2.46	1.05
39	2.50	2.81	-.31
40	3.00	2.75	.26

TABLE XXVII (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	3.50	3.63	- .13
42	2.50	2.62	- .12
43	3.50	3.73	- .23
44	3.50	3.76	- .26
45	3.50	3.28	.23
46	3.00	2.86	.15
47	2.50	2.10	.41
48	3.00	3.07	- .07
49	3.00	3.48	- .48
50	4.00	3.29	.72
51	3.00	3.27	- .27
52	2.50	2.71	- .21
53	3.00	2.95	.06
54	3.00	3.42	- .42
55	2.00	2.49	- .49
56	3.00	2.20	.81
57	3.00	3.21	- .21
58	4.00	3.68	.33
59	4.00	3.66	.35

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value $.56 \times 1.96$. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXVIII

OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS
 IN SCHOOL B

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.97	.04
2	1.50	1.56	-.05
3	2.50	2.25	.25
4	4.00	3.49	.52
5	3.00	2.62	.39
6	3.00	3.10	-.10
7	3.50	2.95	.56
8	3.00	3.56	-.56
9	4.00	3.59	.42
10	3.00	3.68	-.68
11	4.00	2.91	1.10
12	2.00	2.15	-.15
13	3.50	3.83	-.33
14	2.50	3.07	-.57
15	4.00	3.54	.46
16	3.00	3.14	-.14
17	4.00	3.47	.53
18	3.00	3.30	-.30
19	3.00	2.73	-.28
20	2.50	2.77	-.27
21	2.50	2.87	-.37
22	3.00	2.97	.04
23	4.00	3.67	.34
24	2.50	2.23	.28
25	3.00	2.54	.47
26	3.00	2.92	.09
27	3.50	3.07	.44
28	2.50	2.86	-.36
29	2.50	2.29	.21
30	2.00	2.52	-.52
31	3.00	3.64	-.64
32	2.00	2.26	-.26
33	3.50	3.37	.14
34	1.00	1.89	-.89
35	4.00	3.06	.94
36	4.00	4.14	-.14
37	2.00	2.61	-.61
38	2.50	2.89	-.39
39	3.00	2.98	.03
40	3.50	2.82	.68

TABLE XXVIII (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	2.00	2.42	- .42
42	2.50	3.15	- .65
43	2.50	2.61	- .11
44	3.00	3.32	- .32
45	3.50	3.18	.32
46	3.00	3.26	- .26
47	3.00	2.36	.64
48	4.00	3.70	.31
49	2.50	2.94	- .44
50	2.00	2.76	- .76
51	3.50	3.13	.38
52	3.50	3.34	.17
53	4.00	3.45	.56
54	2.00	2.61	- .61
55	3.00	2.89	.12
56	3.00	2.96	.05
57	3.00	3.26	- .26
58	3.00	2.76	.25
59	3.00	2.44	.57
60	3.00	3.16	- .16
61	3.00	3.25	- .25
62	2.00	2.40	- .40
63	3.50	3.67	- .17
64	3.00	2.27	.74
65	3.00	3.46	- .46
66	3.50	3.24	.27

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .47 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXIX

OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS IN
 SCHOOLS A AND B COMBINED

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.66	.35
2	1.00	2.43	-1.43
3	3.50	3.31	.20
4	3.50	2.48	1.03
5	4.00	3.57	.44
6	2.00	2.25	-.25
7	4.00	3.02	.99
8	2.00	2.59	-.59
9	2.00	2.35	-.35
10	4.00	3.02	.99
11	2.00	2.31	-.31
12	3.50	3.08	.43
13	2.00	2.90	-.90
14	3.00	3.44	-.44
15	4.00	3.27	.74
16	3.00	2.63	.38
17	2.00	2.52	-.52
18	3.00	2.66	.35
19	4.00	3.38	.63
20	3.00	2.82	.19
21	4.00	3.02	.99
22	1.00	1.65	-.65
23	3.00	2.65	.36
24	3.00	3.23	-.23
25	4.00	3.44	.57
26	4.00	3.46	.55
27	3.50	2.87	.64
28	3.00	3.07	-.07
29	2.00	2.17	-.17
30	3.50	3.38	.13
31	2.50	2.99	-.49
32	2.50	3.09	-.59
33	3.50	2.58	.93
34	2.50	2.36	.15
35	2.00	3.28	-1.28
36	3.50	3.13	.37
37	3.50	3.33	.18
38	3.50	2.34	1.16
39	2.50	2.62	-.12
40	3.00	2.66	.35

TABLE XXIX (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	3.50	3.25	.26
42	2.50	2.42	.09
43	3.50	3.31	.19
44	3.50	3.54	-.04
45	3.50	3.17	.34
46	3.00	2.81	.20
47	2.50	2.14	.37
48	3.00	3.00	.00
49	3.00	3.30	-.30
50	4.00	3.21	.80
51	3.00	3.15	-.15
52	2.50	2.54	-.04
53	3.00	2.83	.18
54	3.00	3.22	-.22
55	2.00	2.34	-.34
56	3.00	2.12	.89
57	3.00	3.09	-.09
58	4.00	3.58	.43
59	4.00	3.46	.55
60	3.00	2.98	.03
61	1.50	1.60	-.10
62	2.50	2.33	.18
63	4.00	3.50	.51
64	3.00	2.71	.30
65	3.00	3.09	-.09
66	3.50	2.84	.67
67	3.00	3.62	-.62
68	4.00	3.69	.32
69	3.00	3.66	-.66
70	4.00	2.94	1.07
71	2.00	2.39	-.39
72	3.50	3.89	-.39
73	2.50	3.20	-.70
74	4.00	3.66	.35
75	3.00	3.24	-.24
76	4.00	3.59	.42
77	3.00	3.36	-.36
78	3.00	2.85	.15
79	2.50	2.88	-.38
80	2.50	3.05	-.55
81	3.00	3.13	-.13
82	4.00	3.90	.10
83	2.50	2.41	.10
84	3.00	2.63	.38
85	3.00	3.02	-.02
86	3.50	3.17	.34

TABLE XXIX (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
87	2.50	2.93	- .43
88	2.50	2.38	.13
89	2.00	2.52	- .52
90	3.00	3.67	- .67
91	2.00	2.44	- .44
92	3.50	3.26	.25
93	1.00	2.12	-1.12
94	4.00	3.15	.86
95	4.00	4.27	- .27
96	2.00	2.53	- .53
97	2.50	3.01	- .51
98	3.00	3.24	- .24
99	3.50	2.97	.54
100	2.00	2.65	- .65
101	2.50	3.29	- .79
102	2.50	2.79	- .29
103	3.00	3.56	- .56
104	3.50	3.30	.21
105	3.00	3.37	- .37
106	3.00	2.49	.52
107	4.00	3.89	.12
108	2.50	3.08	- .58
109	2.00	2.77	- .77
110	3.50	3.33	.18
111	3.50	3.43	.08
112	4.00	3.67	.34
113	2.00	2.78	- .78
114	3.00	3.06	- .06
115	3.00	3.15	- .15
116	3.00	3.38	- .38
117	3.00	3.01	- .00
118	3.00	2.53	.48
119	3.00	3.15	- .15
120	3.00	3.48	- .48
121	2.00	2.51	- .51
122	3.50	3.93	- .43
123	3.00	2.51	.50
124	3.00	3.77	- .77
125	3.50	3.40	.11

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .53 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

APPENDIX C

TABLE XXX
 OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS
 IN SCHOOL A

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.90	.10
2	1.00	2.45	-1.45
3	3.50	3.18	.33
4	3.50	2.67	.83
5	4.00	3.75	.25
6	2.00	2.12	-.12
7	4.00	3.09	.91
8	2.00	2.69	-.69
9	2.00	2.24	-.24
10	4.00	3.05	.95
11	2.00	2.24	-.24
12	3.50	3.01	.50
13	2.00	3.27	-1.27
14	3.00	3.63	-.63
15	4.00	3.51	.49
16	3.00	2.56	.44
17	2.00	2.59	-.59
18	3.00	2.67	.33
19	4.00	3.82	.18
20	3.00	2.88	.12
21	4.00	3.25	.75
22	1.00	1.63	-.63
23	3.00	2.98	.02
24	3.00	3.20	-.20
25	4.00	3.79	.21
26	4.00	3.79	.21
27	3.50	3.01	.49
28	3.00	3.24	-.24
29	2.00	2.21	-.21
30	3.50	3.78	-.28
31	2.50	3.01	-.51
32	2.50	3.04	-.54
33	3.50	2.93	.57
34	2.50	2.43	.07
35	2.00	3.40	-1.40
36	3.50	3.26	.24
37	3.50	3.65	-.15
38	3.50	2.35	1.15
39	2.50	2.82	-.32
40	3.00	2.55	.46

TABLE XXX (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	3.50	3.52	- .02
42	2.50	2.59	- .09
43	3.50	3.75	- .25
44	3.50	3.68	- .18
45	3.50	3.06	.44
46	3.00	2.71	.29
47	2.50	2.30	.20
48	3.00	3.04	- .04
49	3.00	3.35	- .35
50	4.00	3.42	.58
51	3.00	3.62	- .62
52	2.50	2.86	- .36
53	3.00	2.86	.14
54	3.00	3.58	- .58
55	2.00	2.38	- .38
56	3.00	2.36	.64
57	3.00	3.17	- .17
58	4.00	3.68	.32
59	4.00	3.46	.54

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .57 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXXI
 OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS
 IN SCHOOL B

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	3.01	- .00
2	1.50	1.37	.13
3	2.50	2.26	.24
4	4.00	3.30	.70
5	3.00	2.47	.53
6	3.00	3.04	- .04
7	3.50	3.14	.36
8	3.00	3.63	- .63
9	4.00	3.80	.20
10	3.00	3.43	- .43
11	4.00	3.21	.79
12	2.00	1.82	.19
13	3.50	3.76	- .26
14	2.50	2.82	- .32
15	4.00	3.48	.52
16	3.00	3.25	- .25
17	4.00	3.65	.35
18	3.00	3.46	- .46
19	3.00	3.04	- .04
20	2.50	2.72	- .22
21	2.50	2.91	- .41
22	3.00	3.04	- .04
23	4.00	3.93	.07
24	2.50	2.26	.24
25	3.00	2.50	.50
26	3.00	2.70	.30
27	3.50	2.99	.51
28	2.50	2.70	- .20
29	2.50	2.38	.11
30	2.00	2.31	- .31
31	3.00	3.62	- .62
32	2.00	2.49	- .49
33	3.50	3.34	.16
34	1.00	1.85	- .85
35	4.00	3.47	.53
36	4.00	3.73	.27
37	2.00	2.81	- .81
38	2.50	2.66	- .16
39	3.00	3.20	- .20
40	3.50	2.83	.68

TABLE XXXI (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	2.00	2.29	- .29
42	2.50	2.93	- .43
43	2.50	2.57	- .07
44	3.00	3.24	- .24
45	3.50	3.02	.48
46	3.00	3.23	- .23
47	3.00	2.63	.37
48	4.00	3.74	.26
49	2.50	3.04	- .54
50	2.00	2.63	- .63
51	3.50	3.31	.19
52	3.50	3.16	.34
53	4.00	3.35	.65
54	2.00	2.53	- .53
55	3.00	2.82	.18
56	3.00	2.71	.29
57	3.00	3.10	- .10
58	3.00	2.43	.57
59	3.00	2.57	.44
60	3.00	3.45	- .45
61	3.00	3.41	- .41
62	2.00	2.78	- .78
63	3.50	3.74	- .25
64	3.00	2.36	.64
65	3.00	3.25	- .25
66	3.50	3.34	.16

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .44 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXXII
 OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS IN
 SCHOOLS A AND B COMBINED

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.81	.19
2	1.00	2.31	-1.31
3	3.50	3.37	.13
4	3.50	2.60	.90
5	4.00	3.60	.40
6	2.00	2.35	-.35
7	4.00	3.06	.94
8	2.00	2.52	-.52
9	2.00	2.27	-.27
10	4.00	2.96	1.04
11	2.00	2.37	-.37
12	3.50	2.90	.60
13	2.00	2.88	-.88
14	3.00	3.48	-.48
15	4.00	2.99	1.01
16	3.00	2.52	.48
17	2.00	2.58	-.58
18	3.00	2.71	.29
19	4.00	3.56	.45
20	3.00	2.66	.34
21	4.00	2.93	1.07
22	1.00	1.71	-.71
23	3.00	2.80	.20
24	3.00	3.29	-.29
25	4.00	3.22	.78
26	4.00	3.33	.67
27	3.50	2.67	.83
28	3.00	3.04	-.04
29	2.00	2.33	-.33
30	3.50	3.23	.28
31	2.50	3.12	-.62
32	2.50	2.86	-.36
33	3.50	2.48	1.03
34	2.50	2.25	.25
35	2.00	3.23	-1.23
36	3.50	3.07	.43
37	3.50	3.39	.11
38	3.50	2.38	1.12
39	2.50	2.69	-.19
40	3.00	2.57	.44

TABLE XXXII (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	3.50	3.22	.28
42	2.50	2.39	.11
43	3.50	3.47	.03
44	3.50	3.61	- .11
45	3.50	3.08	.42
46	3.00	2.83	.17
47	2.50	2.49	.01
48	3.00	3.00	.00
49	3.00	3.43	- .43
50	4.00	3.43	.58
51	3.00	3.59	- .59
52	2.50	2.64	- .14
53	3.00	2.82	.18
54	3.00	3.49	- .49
55	2.00	2.26	- .26
56	3.00	2.21	.79
57	3.00	3.25	- .25
58	4.00	3.51	.49
59	4.00	3.33	.67
60	3.00	3.12	- .12
61	1.50	1.57	- .07
62	2.50	2.33	.18
63	4.00	3.35	.65
64	3.00	2.51	.49
65	3.00	2.97	.03
66	3.50	2.99	.52
67	3.00	3.65	- .65
68	4.00	3.71	.30
69	3.00	3.49	- .49
70	4.00	3.04	.96
71	2.00	2.32	- .32
72	3.50	3.75	- .25
73	2.50	3.09	- .59
74	4.00	3.52	.48
75	3.00	3.32	- .32
76	4.00	3.66	.34
77	3.00	3.45	- .45
78	3.00	2.98	.02
79	2.50	2.82	- .32
80	2.50	3.11	- .61
81	3.00	3.17	- .17
82	4.00	3.98	.02
83	2.50	2.46	.04
84	3.00	2.63	.37
85	3.00	2.89	.11
86	3.50	3.13	.37

TABLE XXXII (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
87	2.50	2.86	- .36
88	2.50	2.43	.07
89	2.00	2.50	- .50
90	3.00	3.68	- .68
91	2.00	2.48	- .48
92	3.50	3.29	.21
93	1.00	2.07	-1.07
94	4.00	3.35	.65
95	4.00	4.05	- .05
96	2.00	2.64	- .64
97	2.50	2.85	- .35
98	3.00	3.35	- .35
99	3.50	2.92	.58
100	2.00	2.57	- .57
101	2.50	3.23	- .73
102	2.50	2.69	- .19
103	3.00	3.55	- .55
104	3.50	3.24	.26
105	3.00	3.41	- .41
106	3.00	2.55	.45
107	4.00	3.92	.08
108	2.50	3.08	- .58
109	2.00	2.74	- .74
110	3.50	3.36	.15
111	3.50	3.35	.15
112	4.00	3.55	.45
113	2.00	2.72	- .72
114	3.00	2.93	.07
115	3.00	3.07	- .07
116	3.00	3.17	- .17
117	3.00	2.81	.19
118	3.00	2.51	.49
119	3.00	3.30	- .30
120	3.00	3.42	- .42
121	2.00	2.70	- .70
122	3.50	3.93	- .43
123	3.00	2.47	.53
124	3.00	3.75	- .75
125	3.50	3.43	.07

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .53 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

APPENDIX D

TABLE XXXIII

OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS
 IN SCHOOL A

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.75	.25
2	1.00	2.47	-1.47
3	3.50	3.27	.24
4	3.50	2.59	.91
5	4.00	3.77	.23
6	2.00	2.11	-.11
7	4.00	2.99	1.01
8	2.00	2.66	-.66
9	2.00	2.22	-.22
10	4.00	3.14	.86
11	2.00	2.22	-.22
12	3.50	3.14	.36
13	2.00	3.10	-1.10
14	3.00	3.73	-.73
15	4.00	3.71	.29
16	3.00	2.75	.25
17	2.00	2.65	-.65
18	3.00	2.76	.24
19	4.00	3.61	.39
20	3.00	2.96	.04
21	4.00	3.25	.75
22	1.00	1.55	-.55
23	3.00	2.94	.06
24	3.00	3.27	-.27
25	4.00	3.93	.08
26	4.00	3.82	.18
27	3.50	2.93	.57
28	3.00	3.33	-.33
29	2.00	2.06	-.06
30	3.50	3.70	-.20
31	2.50	2.96	-.46
32	2.50	3.11	-.61
33	3.50	2.82	.68
34	2.50	2.44	.06
35	2.00	3.44	-1.44
36	3.50	3.34	.16
37	3.50	3.49	.01
38	3.50	2.43	1.07
39	2.50	2.81	-.31
40	3.00	2.71	.29

TABLE XXXIII (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	** Residual Values
40	3.00	2.71	.29
41	3.50	3.62	- .12
42	2.50	2.62	- .12
43	3.50	3.70	- .20
44	3.50	3.73	- .23
45	3.50	3.24	.26
46	3.00	2.81	.19
47	2.50	2.09	.41
48	3.00	3.06	- .06
49	3.00	3.43	- .43
50	4.00	3.28	.72
51	3.00	3.26	- .26
52	2.50	2.73	- .23
53	3.00	2.93	.07
54	3.00	3.41	- .41
55	2.00	2.48	- .48
56	3.00	2.21	.79
57	3.00	3.17	- .17
58	4.00	3.69	.31
59	4.00	3.64	.36

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .56 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXXIV

OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS IN
 SCHOOL B

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.81	.19
2	1.50	1.29	.21
3	2.50	2.28	.22
4	4.00	3.49	.51
5	3.00	2.73	.27
6	3.00	3.06	-.06
7	3.50	3.02	.48
8	3.00	3.65	-.65
9	4.00	3.92	.08
10	3.00	3.54	-.54
11	4.00	3.27	.73
12	2.00	1.81	.19
13	3.50	3.93	-.43
14	2.50	2.83	-.33
15	4.00	3.74	.26
16	3.00	3.19	-.19
17	4.00	3.62	.38
18	3.00	3.39	-.39
19	3.00	3.05	-.05
20	2.50	2.77	-.27
21	2.50	2.82	-.32
22	3.00	2.91	.09
23	4.00	3.82	.18
24	2.50	2.23	.28
25	3.00	2.40	.60
26	3.00	2.74	.26
27	3.50	2.97	.53
28	2.50	2.62	-.12
29	2.50	2.33	.17
30	2.00	2.19	-.19
31	3.00	3.57	-.57
32	2.00	2.42	-.42
33	3.50	3.21	.29
34	1.00	1.87	-.87
35	4.00	3.31	.69
36	4.00	3.86	.14
37	2.00	2.75	-.75
38	2.50	2.78	-.28
39	3.00	3.15	-.15
40	3.50	2.86	.65

TABLE XXXIV (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
41	2.00	2.43	- .43
42	2.50	2.90	- .40
43	2.50	2.68	- .18
44	3.00	3.11	- .11
45	3.50	3.06	.45
46	3.00	3.11	- .11
47	3.00	2.71	.29
48	4.00	3.59	.41
49	2.50	3.06	- .56
50	2.00	2.56	- .56
51	3.50	3.29	.21
52	3.50	3.25	.25
53	4.00	3.54	.46
54	2.00	2.56	- .56
55	3.00	2.93	.07
56	3.00	2.53	.47
57	3.00	3.28	- .28
58	3.00	2.51	.49
59	3.00	2.55	.45
60	3.00	3.28	- .28
61	3.00	3.57	- .57
62	2.00	2.67	- .67
63	3.50	3.72	- .22
64	3.00	2.51	.49
65	3.00	3.18	- .18
66	3.50	3.26	.24

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value .43 x 1.96. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

TABLE XXXV

OBTAINED GRADES, PREDICTED GRADES BASED ON
 VARIABLES GPA, G, V, P, N, AND Q, AND
 RESIDUAL VALUES FOR STUDENTS IN
 SCHOOLS A AND B COMBINED

Subject	Obtained Grades	*Predicted Grades	**Residual Values
1	3.00	2.72	.27
2	1.00	2.37	-1.37
3	3.50	3.37	.13
4	3.50	2.53	.98
5	4.00	3.57	.43
6	2.00	2.38	-.38
7	4.00	2.96	1.04
8	2.00	2.53	-.53
9	2.00	2.24	-.24
10	4.00	3.08	.92
11	2.00	2.36	-.36
12	3.50	2.99	.51
13	2.00	2.73	-.73
14	3.00	3.51	-.51
15	4.00	3.18	.82
16	3.00	2.74	.26
17	2.00	2.63	-.63
18	3.00	2.78	.22
19	4.00	3.35	.65
20	3.00	2.74	.26
21	4.00	2.95	1.05
22	1.00	1.75	-.75
23	3.00	2.68	.32
24	3.00	3.35	-.35
25	4.00	3.47	.53
26	4.00	3.41	.59
27	3.50	2.66	.85
28	3.00	3.17	-.17
29	2.00	2.14	-.14
30	3.50	3.16	.34
31	2.50	2.96	-.46
32	2.50	2.85	-.35
33	3.50	2.39	1.12
34	2.50	2.27	.24
35	2.00	3.29	-1.29
36	3.50	3.14	.36
37	3.50	3.20	.30
38	3.50	2.43	1.07
39	2.50	2.60	-.10
40	3.00	2.78	.22

TABLE XXXV (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	** Residual Values
41	3.50	3.24	.26
42	2.50	2.47	.03
43	3.50	3.43	.07
44	3.50	3.66	-1.55
45	3.50	3.24	.26
46	3.00	2.95	.05
47	2.50	2.16	.34
48	3.00	3.06	- .06
49	3.00	3.44	- .44
50	4.00	3.22	.78
51	3.00	3.16	- .16
52	2.50	2.53	- .03
53	3.00	2.91	.09
54	3.00	3.30	- .30
55	2.00	2.36	- .36
56	3.00	2.14	.86
57	3.00	3.23	- .23
58	4.00	3.49	.51
59	4.00	3.49	.51
60	3.00	2.87	.13
61	1.50	1.49	.00
62	2.50	2.29	.21
63	4.00	3.48	.52
64	3.00	2.71	.30
65	3.00	3.07	- .07
66	3.50	2.85	.65
67	3.00	3.66	- .66
68	4.00	3.80	.20
69	3.00	3.65	- .65
70	4.00	3.08	.92
71	2.00	2.26	- .26
72	3.50	3.94	- .44
73	2.50	3.13	- .63
74	4.00	3.76	.24
75	3.00	3.23	- .23
76	4.00	3.64	.36
77	3.00	3.35	- .35
78	3.00	2.95	.05
79	2.50	2.83	- .33
80	2.50	3.02	- .52
81	3.00	3.11	- .11
82	4.00	4.00	- .002
83	2.50	2.36	.14
84	3.00	2.55	.45
85	3.00	2.97	.03
86	3.50	3.13	.37

TABLE XXXV (CONTINUED)

Subject	Obtained Grades	*Predicted Grades	**Residual Values
87	2.50	2.80	- .30
88	2.50	2.37	.13
89	2.00	2.37	- .37
90	3.00	3.64	- .64
91	2.00	2.48	- .48
92	3.50	3.20	.30
93	1.00	2.09	-1.09
94	4.00	3.24	.76
95	4.00	4.14	- .14
96	2.00	2.53	- .53
97	2.50	2.94	- .44
98	3.00	3.28	- .28
99	3.50	2.96	.54
100	2.00	2.61	- .61
101	2.50	3.17	- .67
102	2.50	2.78	- .28
103	3.00	3.51	- .51
104	3.50	3.28	.22
105	3.00	3.32	- .32
106	3.00	2.56	.44
107	4.00	3.89	.12
108	2.50	3.11	- .61
109	2.00	2.69	- .69
110	3.50	3.41	.09
111	3.50	3.37	.13
112	4.00	3.70	.30
113	2.00	2.77	- .77
114	3.00	3.06	- .06
115	3.00	2.93	.07
116	3.00	3.41	- .41
117	3.00	2.89	.11
118	3.00	2.56	.44
119	3.00	3.19	- .19
120	3.00	3.60	- .60
121	2.00	2.57	- .57
122	3.50	3.93	- .43
123	3.00	2.56	.45
124	3.00	3.62	- .62
125	3.50	3.41	.09

*To determine the limits within which a student's predicted score will occur 95 chances in 100 multiply the value $.52 \times 1.96$. The product must be added to and then subtracted from the predicted value to obtain the limits.

**The predicted and residual values have been rounded from eight decimal places to two decimal places which may result in rounding errors.

✓
VITA

Fern Allen Green

Candidate for the Degree of

Doctor of Education

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