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An analysis of correlation scores of factors which contribute to success in the study of algebra

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AN ANALYSIS OF CORRELATION SCORES OF FACTORS
WHICH CONTRIBUTE TO SUCCESS
IN THE STUDY OF ALGEBRA

A Thesis
Presented to
the Faculty of the Department of Education
College of the Pacific

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Ray Irvine Johnson, Jr.
August 1958

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
Statement of the Problem	1
Need for the Investigation	1
The Thesis	2
Brief Summary of Findings	3
II. REVIEW OF THE LITERATURE	6
III. FACTORS WHICH ARE THE BASIS FOR PLACEMENT IN	
ALGEBRA	19
Iowa Algebra Aptitude Test	20
California Mental Maturity Test	21
Grades Received in Eighth Grade Arithmetic	22
Stanford Achievement Tests	22
IV. FACTORS WHICH INDICATE SUCCESS IN THE STUDY	
OF ALGEBRA	24
First Semester Algebra Grades	24
Final Algebra Test	25
V. CORRELATION OF PROGNOSTIC MATERIALS WITH ACTUAL	
ACHIEVEMENT IN ALGEBRA	28
The Computations Made	28
Summary	36
VI. ANALYSIS OF THE CORRELATION FINDINGS	43
Evaluation of the Significance of Findings	43

CHAPTER	PAGE
Correlation of algebra grades and prognostic test	43
Correlation of algebra test and prognostic test	44
Correlation of algebra grades and I.Q. test	44
Correlation of algebra test and I.Q. test	44
Correlation of algebra grades and grade eight arithmetic grades	45
Correlation of algebra test and grade eight arithmetic grades	45
Correlation of algebra grades and arithmetic computation	46
Correlation of algebra test and arithmetic computation	46
Correlation of algebra grades and arithmetic reasoning	46
Correlation of algebra test and arithmetic reasoning	46
VII. FINAL INTERPRETATIONS AND CONCLUSIONS	48
General Summary	48
Recommendations for Further Study	50
BIBLIOGRAPHY.	51
APPENDIX.	53

LIST OF TABLES

TABLE	PAGE
<p>I. Coefficients of Correlation Between Success in Ninth Grade Algebra or General Mathematics and Intelligence Aptitude Test Scores, Previ- ous Scholastic Achievement, and Combinations. . .</p>	9
<p>II. Correlation of First Semester Algebra Grades and Final Algebra Test Results of Two Hundred Students in Santa Rosa Junior High Schools. . .</p>	26
<p>III. Correlation of First Semester Algebra Grades and Algebra Prognostic Test of Two Hundred Students in Santa Rosa Junior High Schools. . .</p>	30
<p>IV. Correlation of Final Algebra Tests Results and Algebra Prognostic Test of Two Hundred Stu- dents in Santa Rosa Junior High Schools</p>	31
<p>V. Correlation of First Semester Algebra Grades and Intelligence Quotient Scores of Two Hundred Students in Santa Rosa Junior High Schools</p>	32
<p>VI. Correlation of Algebra Test Results and In- telligence Quotient Scores of Two Hundred Students in Santa Rosa Junior High Schools. . .</p>	33
<p>VII. Correlation of Algebra Grades and Arithmetic Grades of Two Hundred Students in Santa Rosa Junior High Schools.</p>	34

TABLE	PAGE
VIII. Correlation of Algebra Test Results and Arithmetic Grades of Two Hundred Students in Santa Rosa Junior High Schools.	35
IX. Correlation of Algebra Grades and Arithmetic Computation Scores of Two Hundred Students in Santa Rosa Junior High Schools	37
X. Correlation of Algebra Tests Results and Arithmetic Computation Scores of Two Hundred Students in Santa Rosa Junior High Schools.	38
XI. Correlation of Algebra Grades and Arithmetic Reasoning Scores of Two Hundred Students in Santa Rosa Junior High Schools.	39
XII. Correlation of Algebra Tests Results and Arithmetic Reasoning Scores of Two Hundred Students in Santa Rosa Junior High Schools	40
XIII. Correlation Coefficients of Factors Which Contribute to Success in Algebra and Measures of Successful Achievement in Algebra	41
XIV. Raw Scores for Correlation of Algebra Grades and Algebra Test.	54
XV. Raw Scores for Correlation of Algebra Grades and Algebra Prognostic Test	56
XVI. Raw Scores for Correlation of Algebra Test Results and Algebra Prognostic Test	58

TABLE

PAGE

XVII.	Raw Scores for Correlation of Algebra Grades and I.Q. Scores.	60
XVIII.	Raw Scores for Correlation of Algebra Test Results and I. Q. Scores	62
XIX.	Raw Scores for Correlation of Algebra Grades and Arithmetic Grades.	64
XX.	Raw Scores for Correlation of Algebra Test Results and Arithmetic Grades.	66
XXI.	Raw Scores for Correlation of Algebra Grades and Arithmetic Computation Test.	68
XXII.	Raw Scores for Correlation of Algebra Test Results and Arithmetic Computation Test.	70
XXIII.	Raw Scores for Correlation of Algebra Grades and Arithmetic Reasoning Test.	72
XXIV.	Raw Scores for Correlation of Algebra Test Results and Arithmetic Reasoning Test.	74

CHAPTER I

INTRODUCTION

For many years students have been placed in algebra and mathematics courses in the junior high schools of Santa Rosa on the basis of teacher judgment, intelligence test scores, achievement test scores, and prognostic test scores. Counselors have placed these students in the courses on the basis of their judgment of the above factors. Very little experimental evidence has been presented to weigh the relative importance of the factors which are of prime consideration in the placement of pupils.

I. STATEMENT OF THE PROBLEM

It was the purpose of this study to study how well the eighth grade testing program and the eighth grade report card grades in the junior high schools of Santa Rosa predict the grades received at the conclusion of the first semester of algebra and the scores in the final algebra examination.

II. NEED FOR THE INVESTIGATION

Although the present practice of placement in the algebra courses in Santa Rosa has been followed for a number of years, there has been the feeling that there should be an

objective survey of what is being done. The superintendent of schools expressed an interest in the study for the Santa Rosa schools. Algebra teachers of the two schools involved have expressed concern regarding the validity of some of the measures of placement used. Counselors have indicated that a poor relationship between the eighth grade test results and the grades received has made the placement of students a difficult judgment at times.

The investigator has wanted to know more precisely the relationships that exist between the factors which contribute to success in the study of algebra and actual achievement in the course of instruction in algebra.

The ultimate objective has been to aid in the educational placement of students in the Santa Rosa junior high schools.

III. THE THESIS

To analyze the correlation scores of factors which contribute to success in the study of algebra, data were secured on two hundred ninth grade students chosen at random from the two junior high schools of Santa Rosa. There were eleven correlations made to aid in this analysis.

The factors studied that contributed to success were:

1. The Iowa Algebra Aptitude Test,

2. The California Test of Mental Maturity,
3. Grades received in eighth grade arithmetic, and
4. The Stanford Achievement Test
 - A. Arithmetic computation
 - B. Arithmetic reasoning.

The measures of success in algebra for the purposes of this study were:

1. The grades received at the end of the first semester in algebra, and
2. The results of a final course test in algebra which had been prepared by the instructors at both schools.

In addition to these correlations, the validity of the final test in algebra was tested by a correlation with the grades received in algebra.

The correlation scores were calculated by the Pearson-Product Moment Coefficient of Correlation.

IV. BRIEF SUMMARY OF FINDINGS

In order to interpret the findings of this study it is necessary to refer to an authority regarding the significance of correlation scores:

r from .00 to .20 denotes indifferent or negligible relationship;

r from .20 to .40 denotes low correlation, present but slight;
 r from .40 to .70 denotes substantial or marked relationship;
 r from .70 to 1.00 denotes high to very high relationship.¹

The highest correlation was the correlation of the algebra grades with the results of the final test in algebra for the purposes of determining the validity of the final test prepared by the algebra instructors. This correlation was .62, a score in the range described as a substantial relationship.

The correlations made with the algebra grades showed the following relationships:

1. Grade eight arithmetic marks	.52
2. Arithmetic computation	.46
3. Arithmetic reasoning	.45
4. Intelligence quotient	.38
5. Prognostic test	.38

The correlations made with the final algebra test were in the following order:

1. Arithmetic reasoning	.59
2. Arithmetic computation	.57
3. Grade eight arithmetic marks	.48
4. Intelligence quotient	.46
5. Prognostic test	.39

¹Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Co., 1953), p. 173.

The correlation scores involving the Iowa Algebra Aptitude Test were in the low range with both success standards. Also the correlation of the intelligence quotient scores with the algebra grades was found to be in the low range.

All other correlations made were in the range of scores described as substantial. The grades received in arithmetic as well as the results of the arithmetic computation and reasoning tests correlated substantially with both success factors.

CHAPTER II

REVIEW OF THE LITERATURE

Much has been written in regard to the methods, purposes, and limitations of correlation techniques. Only a brief summary regarding correlation will be given in this study.

Edwards defined the product-moment correlation coefficient:

This coefficient measures the degree to which two variables are associated and is symbolized by r . In terms of absolute size, r may vary from $+1.00$, through zero, to -1.00 . A correlation coefficient of $+1.00$ indicates a perfect positive relationship between two variables; a zero coefficient indicates no relationship; and a -1.00 indicates a perfect negative correlation.²

Lacey described the meaning of correlation scores, "the correlation is high where high values of one variable are associated with the high values of the other."³

The interpretation of positive correlation scores has already been mentioned in this study.⁴

In calculating correlation coefficients, a final or absolute answer is not achieved. The scores must be thought of

²Allen L. Edwards, Statistical Analysis for Students in Psychology and Education (New York: Rinehart and Company, Inc., 1946), p. 80.

³Oliver L. Lacey, Statistical Methods in Experimentation (New York: The Macmillan Company, 1957), p. 162.

⁴Garrett, loc. cit.

as a relative answer for the problem at hand rather than the answer.

A correlation coefficient is always to be judged with reference to the circumstances under which it was obtained. There is no such thing as the correlation between mechanical aptitude and abstract intelligence, for instance, but only a correlation between certain tests of mechanical aptitude and intelligence given for certain groups under different conditions. Correlation coefficients are always to be thought of as relative and never as absolute indices of relationship.⁵

There are limitations in a correlation study which should be mentioned.

Douglass discussed three variables which affect the magnitude of a coefficient of correlation:

First the size of the coefficient is dependent upon the homogeneity of the group upon which it is based. The more heterogeneous the group, the greater the coefficient obtained, other things being equal. Second, obtained coefficients of correlations are smaller than those which would be found if perfect reliable measures of the two variables are employed. Test scores and teachers' marks are never completely reliable. Third, the criteria of achievement are not likely to be fully valid--marks often being measures of docility, promptness, personality, attendance, diplomacy, etc., and test scores as well as marks measuring not all of the desirable objectives of instruction and of course, not in proportion to their relative importance, which indeed is not known with any notable degree of accuracy. Because of these and other reasons it scarcely need be pointed out that comparisons of coefficients based upon the same pupils may be made with much more safety than may be done with coefficients based upon different groups.⁶

⁵Ibid., p. 174.

⁶Harl R. Douglass, "The Prediction of Pupil Success in High School Mathematics," The Mathematics Teacher, XXVII (December, 1935), pp. 489-90.

Still other limitations should be considered when using the measurement of successful achievement as grades and test marks. Some of the factors which influence the correlations are: "absence, poor physical condition, incompatibility with the teacher, the number of hours spent outside of school for remunerative work, home facilities for study, and so on."⁷

One other consideration in analyzing correlation scores is that the correlation score must be thought of as being greater in many cases than the calculated r . Garrett stated, "Because of chance errors an obtained r is always less than the 'corrected' value and hence, in a sense, is a minimum measure of the relationship present."⁸

A summary of most known studies which predicted success in high school mathematics prior to 1936 was made by Douglass. The contents of Table I were made by Douglass to indicate the results of previous studies in this field. From the evidence noted in this table and from his reading about these predictive studies, he came to the following conclusions:

1. Achievement in algebra and geometry may be predicted with a fair degree of accuracy only.

⁷Joseph B. Orleans, "A Study of Probable Success in Algebra and in Geometry," The Mathematics Teacher, XXVII (May, 1934), p. 230.

⁸Garrett, loc. cit.

COEFFICIENTS OF CORRELATION BETW
OR GENERAL MATHEMATICS AND INT
PREVIOUS SCHOLASTIC ACHIE

AUTHOR	DATE	CRITERION
Bright	1921	Final Exam. Scores
Bright	1921	Teachers' Marks
Dickter	1933	Breslach Algebra Tests
Grover	1932	Tests
Kertes	1932	1st Sem. Teachers' Marks
Lee and Hughes	1934	Pol. Res. Bureau Alg. Test
Lee and Hughes	1934	Pol. Res. Bureau Alg. Test
Lee and Hughes	1934	Teachers' Marks
Lee and Hughes	1934	Teachers' Marks
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
Proctor	1921	Marks
Seltzer	1922	Semester Teachers' Marks
Short	1927	Douglass Diag. Alg. Tests
Short	1927	Douglass Diag. Alg. Tests
Short	1927	Douglass Diag. Alg. Tests
Short	1927	Douglass Diag. Alg. Tests
Short	1927	Douglass Diag. Alg. Tests
Brooks	1929	Marks
Brooks	1929	Marks
Brooks	1929	Marks
Buchingham	1921	Marks
Buchingham	1921	Marks
Crathorne	1922	Marks
Dickinson	1925	Marks
Elder	1926	Teachers' Marks
Hooks	1922	Marks
Jordan	1922	Marks
Jordan	1922	Marks
Jordan	1922	Marks
Jordan	1922	Marks
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
Ohlson	1927	Marks
Ross	1925	Marks

B I

MEAN SUCCESS IN NINTH GRADE ALGEBRA
 INTELLIGENCE, APTITUDE TEST SCORES,
 COMMENTS, AND COMBINATIONS¹⁰

VARIABLE	N	PLACE	r
I.Q. (Terman)	142	Leavenworth, Kans., HS	.44
I.Q. (Terman)	142	Leavenworth, Kans., HS	.50
I.Q. (Otis Group)	83	Upper Darby JHS	.54
I.Q. (Terman)	71	Oakland JHS	.48
I.Q. (Terman)	114	Perth Amboy, N.J.,	.56
I.Q. (Kuhlman, Anderson)	197	3 Calif. JHS	.56
I.Q. (Terman)	197	3 Calif. JHS	.47
I.Q. (Kuhlman, Anderson)	197	3 Calif. JHS	.48
I.Q. (Terman)	197	3 Calif. JHS	.44
I.Q. (Terman)	24	Palo Alto, Calif., HS	.47
I.Q. (Terman)	28	Palo Alto, Calif., HS	.34
I.Q. (Terman)	32	Palo Alto, Calif., HS	.54
I.Q. (Terman)	48	Palo Alto, Calif., HS	.57
I.Q. (Terman)	116	Palo Alto, Calif., HS	.42
Stanford I.Q. (Stanford Bin.)		Palo Alto, Calif., HS	.46
I.Q. (Otis S.A.)	100	St. Clair, Pa., HS	.57
I.Q. (Terman)	119	Minneapolis HS	.38
I.Q. (Terman)	86	Minneapolis HS	.45
I.Q. (Terman)	45	Minneapolis HS	.39
I.Q. (Terman)	65	Minneapolis HS	.67
I.Q. (Terman)	315	Minneapolis HS	.50
Mental Age (Illinois)	73	Baltimore JHS	.42
Mental Age (National)	73	Baltimore JHS	.30
Teachers' Est. of Intell.	73	Baltimore JHS	.23
Army Alpha		Urban, Ill., HS	.38
Terman Group		Urban, Ill., HS	.25
Av. of 2 Mental Tests			.50
Pressey Mental Survey Sc.	149	Logansport, Ind., HS	.23
P.R. (Otis S.A.) plus Indiana			
Mental Scale No. 1	50	Monticello, Ind., HS	.60
P.R. Otis Group	82		.31
Army Alpha Test Score	47	Univ. of Ark., HS	.51
Miller Test Score	47	Univ. of Ark., HS	.46
Otis Group Test Score	47	Univ. of Ark., HS	.43
Terman Test Score	47	Univ. of Ark., HS	.44
Terman Intell. Score	32	Palo Alto, Calif., HS	.27
Terman Intell. Score	24	Palo Alto, Calif., HS	.32
Terman Intell. Score	28	Palo Alto, Calif., HS	.27
Terman Intell. Score	32	Palo Alto, Calif., HS	.31
Terman Intell. Score	116	Palo Alto, Calif. HS	.31
Terman Intell. Score	48	Palo Alto, Calif., HS	.43
Terman Group Score	476	Everett, Wash., HS	.35
Terman Intell. Test	79	Des Moines, Ia., HS	.42

TABLE I

AUTHOR	DATE	CRITERION
Dickinson	1925	Marks
Dickinson	1925	Marks
PROGNOSTIC AND		
Dickter	1933	Breslich Algebra Test
Grover	1932	Columbia Research Test
Jordan	1922	Marks
Jordan	1922	Marks
Kelley	1914	Marks
Kelley	1914	Marks
Kertes	1932	1st Sem. Teachers' Marks
Lee and Hughes	1934	Pol. Res. Bureau Alg. Test
Lee and Hughes	1934	Pol. Res. Bureau Alg. Test
Lee and Hughes	1934	Teachers' Marks
Lee and Hughes	1934	Teachers' Marks
Orleans	1928-1930	Columbia Research
Rogers	1916	Teachers' Marks
Rogers	1916	Teachers' Marks
Rogers	1923	Teachers' Marks
Ross	1925	Marks
Ross	1925	Marks
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
McCuen	1930	Douglass 1st Sem. Alg. Tests
Seltzer	1932	Semester Teachers' Marks
Seltzer	1932	Semester Teachers' Marks
TEACHERS' MARKS		
Brooks	1929	Marks
Brooks	1929	Marks
Brooks	1929	Marks
Dickter	1933	Breslich Alg. Tests
French	1927	Marks
French	1927	Marks
Kertes	1932	1st Sem. Teachers' Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks

(Continued)

VARIABLE	N	PLACE	r
Thorndyke Visual Vocabulary Test	149	Logansport, Ind., HS	.45
Thorndyke-McCall Silent Reading Test	149	Logansport, Ind., HS	.43
ACHIEVEMENT TESTS			
Rogers' Test of Math Abil.	83	Upper Darby, Pa., JHS	.64
Orleans Prognostic Test	71	Oakland JHS	.61
Abil. Prob. part of Otis Test	47	Univ. of Ark., HS	.68
Hard Oral Directions part of Army Alpha	47	Univ. of Ark., HS	.61
Alg. Aptitude Test	123	2 New York City HS	.47
Math Interest Test	123	2 New York City HS	.30
Orleans Prognostic Test	114	Perth Amboy, N.J.	.61
Lee Apt. of Alg. Ability	197	3 Calif. JHS	.62
Teachers' Est. of Math Abil.	197	3 Calif. JHS	.53
Lee Apt. Test for Alg.	197	3 Calif. JHS	.46
Teachers' Est. of Alg. Abil.	197	3 Calif. JHS	.59
Orleans Prognostic	29	Large New York City HS 17 r's from .51-.80 Av.	.63
Rogers' Math. Abil. Test	53	Wadlwich HS, NY (girls)	.70
Rogers' Math. Abil. Test	61	Horace Mann HS (girls)	.68
Rogers' Math. Abil. Test	26-		
	115	10 HS	.34 to .76
Thorndyke-McCall Reading Test	79	Des Moines, Ia., HS	.31
Woods-McCall Arith. Test	79	Des Moines, Ia., HS	.46
Stanford Arith. Ach. Test	48	Palo Alto, Calif., HS	.46
Stanford Arith. Comp. Test	48	Palo Alto, Calif., HS	.36
Stanford Arith. Reason. Test	48	Palo Alto, Calif., HS	.39
Courtis Arith. Addition	100	St. Claire, Pa., HS	.44
Courtis Arith. Multip.	100	St. Claire, Pa., HS	.49
AND OTHERS			
Av. Marks, Gd. 6	73	Baltimore JHS	.25
Av. Marks, Gd. 7	73	Baltimore JHS	.45
Av. Marks, Gd. 8	73	Baltimore JHS	.61
Marks on 8th gd. Arith.	83	JHS, Upper Darby, Pa.	.61
8th Gd. Arith. Marks		Martinsville, Ind., HS	.14
Stanford Ach. Test in Arith.		Martinsville, Ind., HS	.32
8th Gd. Arith. Marks	114	Perth Amboy, N.J.	.63
Marks in various studies in all grades			.08
Av. 8th gd. Marks	134	New Rochelle, N.Y., HS	to .50
Arith. Marks, Gd. 7	134	New Rochelle, N.Y., HS	.30
Arith. Marks, Gd. 8	134	New Rochelle, N.Y., HS	.32
Arith. Marks, Gd. 8	134	New Rochelle, N.Y., HS	.39
Arith. Marks, Gd. 7 and 8	134	New Rochelle, N.Y., HS	.42

TABLE I

AUTHOR	DATE	CRITERION
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Ross	1925	Marks
Lee and Hughes	1934	Pol. Res. Bur. Alg. Test
Lee and Hughes	1934	Pol. Res. Bur. Alg. Test
Lee and Hughes	1934	Teachers' Marks
Lee and Hughes	1934	Teachers' Marks
Ross	1925	Marks
Ross	1925	Marks

COMBIN

Dickter	1933	Breslich Test
Dickter	1933	Breslich Test
Dickter	1933	Breslich Test
Dickter	1933	Breslich Test
French	1927	Marks
Glover	1932	Columbia Research Test
Kelley	1914	Marks
Kelley	1914	Marks
Kelley	1914	Marks
Kertes	1932	1st Sem. Marks
Kertes	1932	1st Sem. Marks
Kertes	1932	1st Sem. Marks

(continued)

VARIABLE	N	PLACE	F
Arith. Marks, Gds. 2-8	134	New Rochelle, N.Y., HS	.38
English Marks, Gd. 7	134	New Rochelle, N.Y., HS	.26
English Marks, Gd. 8	134	New Rochelle, N.Y., HS	.34
English Marks, Gds. 8,9	134	New Rochelle, N.Y., HS	.35
English Marks, Gds. 2-8	134	New Rochelle, N.Y., HS	.34
Grade School Composite	134	New Rochelle, N.Y., HS	.42 to .51
Grade School Composite	79	Des Moines, Ia., HS	.51 to .55
Arith. Marks in Various Grades	134	New Rochelle, N.Y.	.10 to .39
Eng. Marks in Various Grades	134	New Rochelle, N.Y.	.09 to .34
Elem. Sch. Composite	134	New Rochelle, N.Y.	.42 to .51
Hughes Trait Rating Scale	197		.39
Chronological Age	197		.35
Hughes Trait Rating Scale	197		.60
Chronological Age	197		.39
Attendance, Gds. 7, 8	134	New Rochelle, N.Y., HS	.01
Deportment, Gds. 7, 8	134	New Rochelle, N.Y., HS	.14
ACTIONS			
I.Q. (Otis) and Rogers' Test of Math. Ability	83	Upper Darby, Pa., JHS	.66
I.Q. (Otis) and 8th Gd. Arith. Marks	83	Upper Darby, Pa., JHS	.70
Rogers' Test and 8th Gd. Marks	83	Upper Darby, Pa., JHS	.73
Rogers Test and 8th Gd. Marks and I.Q. (Otis)	83	Upper Darby, Pa., JHS	.74
8th Gd. Marks, Otis I.Q. Stanford Ach., Test Scores and Age		Martinsville, Ind., HS	.49
I.Q. (Terman) and Orleans Prognostic Test	136	2 Oakland JHS	.65
Alg. Apt. and Math Interest	123	2 New York City HS	.49
4th, 5th, 6th, and 7th Arithmetic	59	2 New York City HS	.58
Elem. School Grades, Teachers' Charact. Est., Alg. Int., and Apt. Test	33	2 New York City HS	.81
I.Q. (Terman), and 8th Gd. Arith. Marks	114	Perth Amboy, N.J.	.66
I.Q. (Terman), and Orleans Prognostic Test	114	Perth Amboy, N.J.	.68
Orleans Prog. Test and 8th Gd. Arith. Marks	114	Perth Amboy, N.J.	.72

TABLE I

<u>AUTHOR</u>	<u>DATE</u>	<u>CRITERION</u>
Kertes	1932	1st Sem. Marks
Lee and Hughes	1934	Col. Res. Alg. Test
Lee and Hughes	1934	Col. Res. Alg. Test
Lee and Hughes	1934	Col. Res. Alg. Test

¹⁰Ibid., pp. 495-99.

(continued)

VARIABLE	N	PLACE	r
I.Q. (Terman) and Orleans Prog. Test and 8th Gd. Marks	114	Perth Amboy, N.J.	.68
Lee Apt. Test for Alg. and Hughes Trait Rating Scale	197	3 Calif. JHS	.66
Lee Apt. Test for Alg. and I.Q. (Kuhlman, Anderson)	197	3 Calif. JHS	.65
Hughes Trait Ratings and Kuhlman and Anderson I.Q.	197	3 Calif. JHS	.59

2. Achievement cannot be predicted satisfactorily from any one variable for the purposes of homogeneous or ability grouping or definite advice relative to taking or not taking algebra or geometry.
3. Achievement is best predicted by a combination of the following variables--a good prognostic test, I.Q., and average marks in previous year's or two years' work.
4. While the relative order of merit is not clearly established, it would seem that the better variables used for prediction of success have something like the following rank in order of validity though there is little choice between the variables A and B; variables C and D; and variables E, F, and G.
 - A. good prognosis test
 - B. average marks in previous year
 - C. I.Q.
 - D. previous teacher's estimate of mathematics ability
 - E. M.A.
 - F. achievement test or marks in previous year's work in mathematics
 - G. chronological age
 - H. character trait rating.⁹

In this chapter some of the items reviewed in regard to correlation were:

1. Variables affecting correlation,
2. Limitations of correlation techniques,
3. Proper analysis of correlation scores,
4. Summary of previous studies in Table II, and
5. A summary of conclusions made on the basis of a study of previous studies of a similar nature.

⁹Douglass, op. cit., p. 492.

In the ensuing chapters these points as brought out in the review of the literature are compared with this particular study.

CHAPTER III

FACTORS WHICH ARE THE BASIS FOR PLACEMENT IN ALGEBRA

Students in the ninth grade of the junior high schools of Santa Rosa are placed in either algebra or a course of simplified general review mathematics. Students who are thought to have the ability to succeed in algebra are placed in algebra. There is no one measure used in Santa Rosa to make this pupil placement. The counselor reviews the factors which come into consideration and then makes a judgment as to the proper placement. The counselor considers such data as the Iowa Algebra Aptitude Test, the arithmetic portion of the Stanford Achievement Test, the intelligence quotient scores, and also the mathematics marks received during the eighth grade.

Occasionally parents have requested that their children be placed in the algebra course even though the judgment of the counselor has been that the student would have but little chance to succeed in the course. In such circumstances as these the wishes of the parents have been accepted for a trial period of six weeks during the ninth year after the counselor has warned of possible failure in algebra.

Much depends upon the good judgment of the counselor in proper placement of students.

I. IOWA ALGEBRA APTITUDE TEST

Near the conclusion of the eighth grade all students are administered the Iowa Algebra Aptitude Test as a prognostic measure of success in the study of algebra. This test is used in an attempt to supply reliable guidance information in anticipation of success or failure in algebra. This particular test has some merit in discussions with parents regarding the achievement in algebra, as the test was devised for this purpose alone.

This particular test has been in use for over twenty-five years. Over the years it has been reduced to a thirty-five minute test consisting of arithmetic, abstract computation, numerical series, and dependence and variation. The test is scored on a percentile position. If a student received a percentile score of sixty, this would mean that forty pupils out of a hundred would excel this student in the study of algebra. The recommendation made from the test is that students ranking below the twenty-fifth percentile would find the subject so difficult that they should be excluded or else be diverted into a course of simplified mathematics.¹¹ This practice of eliminating the students scoring below the twenty-fifth

¹¹Harry A Green and Alva H. Piper, The Iowa Algebra Aptitude Test Examiner's Manual for Revised Edition. Bureau of Educational Research and Service (Iowa City: State University of Iowa, 1942), pp. 5-19.

percentile has been followed in Santa Rosa provided that all other measurements point to probable failure.

II. CALIFORNIA MENTAL MATURITY TEST

In the schools of Santa Rosa intelligence quotient tests are given in grades one, three, six, and nine. The California Mental Maturity Test is the test given to pupils in the sixth and ninth grades. In this study the scores received at the start of the ninth grade were the scores used, unless the score departed too far from previous indications of intelligence.

The California Mental Maturity Test is a one period group test of mental maturity. The test is made up of spatial relationships, logical reasoning, numerical reasoning, and verbal concepts. The instruction manual cautions that this test is not to be used alone in the prediction of individual achievement, as a single measure is not enough.¹²

All other things being near equal the counselor places the students with an intelligence quotient of one hundred and above in algebra.

¹²Elizabeth T. Sullivan, Willis W. Clark, and Ernest Tiegs, California Short-Form Test of Mental Maturity Manual, 1950 S-Form (Los Angeles: California Test Bureau, 1950), pp. 2-8.

III. GRADES RECEIVED IN EIGHTH GRADE ARITHMETIC

Still another factor of counselor consideration is the grades received in both semesters of eighth grade arithmetic. The marks received as well as the opinion of the teacher as to the ability level of the pupil have an influence on the course placement. Normally grades of C and above are needed for recommendation for algebra.

IV. STANFORD ACHIEVEMENT TESTS

From the Stanford Achievement Test the counselor reviews the results in arithmetic computation and arithmetic reasoning. These tests are taken by the students near the end of the eighth grade. A score of close to ninth grade ability in both sections of the arithmetic part of the test has been the standard for algebra recommendation if these scores are in line with other factors.

The Stanford Achievement Test was first issued in 1923. The present edition is the fourth revision. The advanced battery is the test used for junior high pupils. This test is fundamentally a power test rather than a speed test.

The test is scored by grade placement of pupils. The end score in both computation and reasoning indicates the level of performance by grade of the individual. A performance score of 9.6 would indicate an average performance by a ninth

grade student at the middle of the ninth year.¹³

In this chapter the factors which are the basis for algebra placement have been discussed. In the next chapter the measures of successful achievement are reviewed.

¹³Truman L. Kelley and others, Stanford Achievement Test (New York: The World Book Company, 1953), pp. 1-2.

CHAPTER IV

FACTORS WHICH INDICATE SUCCESS IN THE STUDY OF ALGEBRA

As has been mentioned, the indication of success in this writing has been the grades received at the conclusion of the first semester of algebra and the results of a final algebra test prepared by instructors in the Santa Rosa School System. Both indicators of success used in this study have weaknesses. Grades too often are more subjective than desirable with aspects other than learning and performance being the indices of the grade received. Tests are never completely reliable in measuring the content of the course learned by each individual. However, these measures of success are frequently accepted by statisticians, as is evidenced by Table I in this thesis. Statisticians have frequently employed grades and tests as success standards with a full knowledge of the limitations of these factors as standards.

I. FIRST SEMESTER ALGEBRA GRADES

The first semester of algebra grades were gathered for the two hundred ninth grade pupils that were included in this project. Plus and minus grades did not enter into the correlation picture, as the final semester grades given in Santa Rosa

do not include a plus or a minus. For the purpose of the correlation calculation the following procedure was employed:

1. Grade A given a value of 5
2. Grade B given a value of 4
3. Grade C given a value of 3
4. Grade D given a value of 2.

No grades of F were included in the correlations, as all failing students had already dropped the course of algebra before the conclusion of the first semester.

These grades were obtained from four instructors at the two junior high schools.

II. FINAL ALGEBRA TEST

The four algebra instructors, two from each junior high school, collaborated in the construction of a final algebra test. The test was made with varying steps of difficulty to get a wide range of scores. Students were allowed a forty-five minute period of time to complete the twenty questions which were included in the examination. A complete range of scores from zero to twenty was obtained.

This test was constructed for usage during this past year. Consequently there is no check of the previous usage of the test as a measure of validity. The test results were correlated with the algebra grades with an r of .62. Table II

TABLE II

CORRELATION OF FIRST SEMESTER ALGEBRA GRADES AND FINAL
ALGEBRA TEST RESULTS OF TWO HUNDRED STUDENTS
IN SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 694$$

$$EY = 1,501$$

$$EX^2 = 2,560$$

$$EY^2 = 14,967$$

$$EXY = 5,670$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 14,967 - \frac{(1501)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 3,702$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 5,670 - \frac{(694)(1,501)}{200}$$

$$Exy = 461.53$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(151.82)(3,702)} = 749.692$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{461.53}{749.692} = .62$$

gives the summary of the computation of this correlation score.

In the next section of this study the actual correlation of the prognostic materials and the achievement standards is made.

CHAPTER V

CORRELATION OF PROGNOSTIC MATERIALS WITH ACTUAL ACHIEVEMENT IN ALGEBRA

The correlation findings are shown in this section of the thesis. In order to clarify the actual computation procedures and to include the significant numerical data of the correlations, tables were prepared which illustrate the points covered. There were ten correlations made of the prognostic materials and the achievement standards. Five correlations were made with each one of the success factors of the study. All correlations were calculated by the Pearson-Product Moment Coefficient of Correlation.

I. THE COMPUTATIONS MADE

The correlations involving the Iowa Algebra Aptitude Test with the grades and the test scores did not prove to be very high correlations. The correlation of the Iowa Algebra Aptitude Test with the first semester grades was .38, and the r with the final test was .39. The correlation of the prognostic test and the final algebra test was slightly higher than with the grades. These r 's both fell in the range described as a low correlation, present but slight. The results indicated that this particular prognostic test did not serve well

as a single predictor of success.

These tabulations appear in Tables III and IV.

The correlations of success factors with the California Mental Maturity Tests again showed the correlation to be higher with the final test than with the grades received in algebra. The r with the final test was .46, whereas the r with the marks was but .38. This coefficient of .38 was the same as found with grades and the prognostic test. The relationship of the final test and the intelligence quotient scores is considered substantial, although the r with grades is in the low correlation range.

Tables V and VI show these scores.

The eighth grade final arithmetic marks showed a different relationship than found in the other correlations. This comparison showed that the mathematics grades were more closely related to the algebra marks than to the final algebra test. The r with the algebra grades was .52, while the r with the final examination in algebra was .48. Both of these r 's are considered marked relationship values. The grade eight arithmetic marks had a higher correlation with both success standards than did either the prognostic test or the intelligence scores.

These results are illustrated in Tables VII and VIII.

The correlation coefficients obtained from the arithmetic computation section of the Stanford Achievement Test

TABLE III
CORRELATION OF FIRST SEMESTER ALGEBRA GRADES AND
ALGEBRA PROGNOSTIC TEST OF TWO HUNDRED STUDENTS
OF SANTA ROSA JUNIOR HIGH SCHOOL

$$EX = 694$$

$$EY = 10,868$$

$$EX^2 = 2,560$$

$$EY^2 = 661,840$$

$$EXY = 38,974$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 661,840 - \frac{(10,868)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 71,272.88$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 38,974 - \frac{7,542,392}{200}$$

$$Exy = 1,262.04$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(151.82)(71,272.88)} = 3,289.475$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{1,262.04}{3,289.475} = .38$$

TABLE IV

CORRELATION OF FINAL ALGEBRA TEST RESULTS AND ALGEBRA
PROGNOSTIC TEST OF TWO HUNDRED STUDENTS IN SANTA
ROSA JUNIOR HIGH SCHOOLS

$$EX = 1,501$$

$$EY = 10,868$$

$$EX^2 = 14,967$$

$$EY^2 = 661,840$$

$$EXY = 87,967$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 14,967 - \frac{(1501)^2}{200}$$

$$Ey^2 = 661,840 - \frac{(10,868)^2}{200}$$

$$Ex^2 = 3,702$$

$$Ey^2 = 71,272.88$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 87,967 - \frac{(1501)(10,868)}{200}$$

$$Exy = 6,402.66$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(3,702)(71,272.88)} = 16,243.53$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{6,402.66}{16,243.53} = .39$$

TABLE V

CORRELATION OF FIRST SEMESTER ALGEBRA GRADES AND
INTELLIGENCE QUOTIENT SCORES OF TWO HUNDRED
STUDENTS IN SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 694$$

$$EY = 22,340$$

$$EX^2 = 2,560$$

$$EY^2 = 2,518,032$$

$$EXY = 78,219$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 2,518,032 - \frac{(22,340)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 22,654$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 78,219 - \frac{(694)(22,340)}{200}$$

$$Exy = 699.20$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(151.82)(22,654)} = 1,854.543$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{699.20}{1,854.543} = .38$$

TABLE VI

CORRELATION OF ALGEBRA TEST RESULTS AND INTELLIGENCE
 QUOTIENT SCORES OF TWO HUNDRED STUDENTS IN
 SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 1,501$$

$$EY = 22,340$$

$$EX^2 = 14,967$$

$$EY^2 = 2,518,032$$

$$EXY = 171,916$$

$$E_x^2 = EX^2 - \frac{(EX)^2}{n}$$

$$E_y^2 = EY^2 - \frac{(EY)^2}{n}$$

$$E_x^2 = 14,967 - \frac{(1501)^2}{200}$$

$$E_y^2 = 2,518,032 - \frac{(22,340)^2}{200}$$

$$E_x^2 = 3,702$$

$$E_y^2 = 22,654$$

$$E_{xy} = EXY - \frac{(EX)(EY)}{n}$$

$$E_{xy} = 171,916 - \frac{(1501)(22,340)}{200}$$

$$E_{xy} = 4,254.3$$

$$\sqrt{(E_x^2)(E_y^2)} = \sqrt{(3702)(22,654)} = 9,157.79$$

$$r = \frac{E_{xy}}{\sqrt{(E_x^2)(E_y^2)}} = \frac{4254.3}{9157.79} = .46$$

TABLE VII

CORRELATION OF ALGEBRA GRADES AND ARITHMETIC GRADES
OF TWO HUNDRED STUDENTS IN SANTA ROSA
JUNIOR HIGH SCHOOLS

$$EX = 694$$

$$EY = 772$$

$$EX^2 = 2,560$$

$$EY^2 = 3,090$$

$$EXY = 2,746$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 3,090 - \frac{(772)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 110.08$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 2,746 - \frac{535,768}{200}$$

$$Exy = 67.16$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{16,712.3456} = 129.276$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{67.16}{129.276} = .52$$

TABLE VIII

CORRELATION OF ALGEBRA TEST RESULTS AND ARITHMETIC
GRADES OF TWO HUNDRED STUDENTS IN SANTA
ROSA JUNIOR HIGH SCHOOLS

$$EX = 1,501$$

$$EY = 772$$

$$EX^2 = 14,967$$

$$EY^2 = 3,090$$

$$EXY = 6,102$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 14,967 - \frac{(1,501)^2}{200}$$

$$Ey^2 = 3,090 - \frac{(772)^2}{200}$$

$$Ex^2 = 3,702$$

$$Ey^2 = 110.08$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 6,102 - \frac{(1,501)(772)}{200}$$

$$Exy = 308.14$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(3,702)(110.08)} = 638.37$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{308.14}{638.37} = .48$$

and the achievement factors were both substantial relationships. The r with the algebra grades was .46, and the r with the final test was .57. With the two hundred students tested, the relationship of arithmetic computation scores and the achievement factors was higher than those of the prognostic test, the intelligence scores, and the eighth grade arithmetic marks with the exception of the r of the eighth grade marks and the ninth grade algebra marks.

In tables IX and X the facts regarding the relationship of arithmetic computation and success factors are shown.

The final correlations involving the arithmetic reasoning portion of the Stanford Achievement Test were quite similar to those obtained with the arithmetic computation section. In this case, the arithmetic reasoning r with grades was .45, while the r with final test scores was .59. These scores were both rated as marked relationship.

Tables XI and XII include the information regarding the correlations of arithmetic reasoning scores and grades and final test scores.

II. SUMMARY

To summarize the correlation findings, Table XIII has been prepared. In this table each factor which contributes to success in algebra was correlated with the two measures of success; i.e., the grades received and the final test score.

TABLE IX

CORRELATION OF ALGEBRA GRADES AND ARITHMETIC
COMPUTATION SCORES OF TWO HUNDRED STUDENTS
IN SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 694$$

$$EY = 1,850.9$$

$$EX^2 = 2,560$$

$$EY^2 = 17,603.67$$

$$EXY = 6,547.3$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 17,603.67 - \frac{(1,850.9)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 474.516$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 6,547.3 - \frac{(694)(1,850.9)}{200}$$

$$Exy = 124.677$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(151.82)(474.516)} = 268.405$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{124.677}{268.405} = .46$$

TABLE X

CORRELATION OF ALGEBRA TEST RESULTS AND ARITHMETIC
COMPUTATION SCORES OF TWO HUNDRED STUDENTS
IN SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 1,501$$

$$EY = 1,850.9$$

$$EX^2 = 14,967$$

$$EY^2 = 17,603.67$$

$$EXY = 14,649.9$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 14,967 - \frac{(1501)^2}{200}$$

$$Ey^2 = 17,603.67 - \frac{(1850.9)^2}{200}$$

$$Ex^2 = 3,702$$

$$Ey^2 = 474.516$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 14,649.9 - \frac{(1501)(1850.9)}{200}$$

$$Exy = 758.896$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(3,702)(474.516)} = 1,325.390$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{758.896}{1,325.39} = .57$$

TABLE XI

CORRELATION OF ALGEBRA GRADES AND ARITHMETIC
REASONING SCORES OF TWO HUNDRED STUDENTS
IN SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 694$$

$$EY = 1,939.7$$

$$EX^2 = 2,560$$

$$EY^2 = 19,415.49$$

$$EXY = 6,868.4$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 2,560 - \frac{(694)^2}{200}$$

$$Ey^2 = 19,415.49 - \frac{(1,939.7)^2}{200}$$

$$Ex^2 = 151.82$$

$$Ey^2 = 603.31$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 6,868.4 - \frac{(694)(1,939.7)}{200}$$

$$Exy = 137.64$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(151.82)(603.31)} = 302.646$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{137.64}{302.646} = .45$$

TABLE XII

CORRELATION OF ALGEBRA TEST RESULTS AND ARITHMETIC
REASONING SCORES OF TWO HUNDRED STUDENTS IN
SANTA ROSA JUNIOR HIGH SCHOOLS

$$EX = 1,501$$

$$EY = 1,939.7$$

$$EX^2 = 14,967$$

$$EY^2 = 19,415.49$$

$$EXY = 15,444.4$$

$$Ex^2 = EX^2 - \frac{(EX)^2}{n}$$

$$Ey^2 = EY^2 - \frac{(EY)^2}{n}$$

$$Ex^2 = 14,967 - \frac{(1,501)^2}{200}$$

$$Ey^2 = 19,415.49 - \frac{(1,939.7)^2}{200}$$

$$Ex^2 = 3,702$$

$$Ey^2 = 603.31$$

$$Exy = EXY - \frac{(EX)(EY)}{n}$$

$$Exy = 15,444.4 - \frac{(1,501)(1,939.7)}{200}$$

$$Exy = 886.952$$

$$\sqrt{(Ex^2)(Ey^2)} = \sqrt{(3702)(603.31)} = 1,494.474$$

$$r = \frac{Exy}{\sqrt{(Ex^2)(Ey^2)}} = \frac{886.952}{1494.474} = .59$$

TABLE XIII
CORRELATION COEFFICIENTS OF FACTORS WHICH CONTRIBUTE
TO SUCCESS IN ALGEBRA AND MEASURES OF
SUCCESSFUL ACHIEVEMENT IN ALGEBRA

	Algebra Grades	Algebra Test
Prognostic Test	.38	.39
Intelligence Quotient	.38	.46
Grade 8 Arithmetic Mark	.52	.48
Arithmetic Computation	.46	.57
Arithmetic Reasoning	.45	.59

The three top correlations with both success factors were arithmetic reasoning, arithmetic computation, and grade eight arithmetic marks. These coefficients were all significant findings.

The grade eight arithmetic marks correlated higher with the algebra grades than with the final algebra examination.

The intelligence quotient and the prognostic test r's were last on the scale on both measurements. However, the correlation of the intelligence quotients and the final algebra test was a high enough relationship to be classified as substantial.

Further analysis of these findings appears in the next section.

CHAPTER VI

ANALYSIS OF THE CORRELATION FINDINGS

Prior to 1936 there were many correlation studies made of the prediction of successful achievement in the study of algebra. Fortunately, much of this research had been collected and tabulated by Douglass in the form presented in Table I, page 9, of this thesis. In this chapter of the thesis, the statistics obtained in this study are compared with the previous investigations of similar materials. In all cases, unless otherwise noted, the references to previous studies were obtained from Table I.

I. EVALUATION OF THE SIGNIFICANCE OF FINDINGS

Correlation of algebra grades and prognostic test.

Some of the studies made in this field were:

1. Study by Kelley in 1914 of the r of marks and an algebra aptitude test of 123 students of New York City, resulting in an r of .47.
2. The Kertes report in 1932 of first semester algebra marks and the Orleans Prognostic Test of 123 students with an r of .61, and
3. The Lee and Hughes study of 197 Oakland students of the relationship of marks and the Lee Aptitude Test in Algebra with an r of .46.

These correlation coefficients were all higher than the .38 correlation found in the study by the use of the Iowa Algebra Aptitude Test.

Correlation of algebra test and prognostic test. The previous correlations here for standardized test averaged a little above an r of .60. Some of these studies were:

1. Grover's 1932 correlation of the Columbia Research Test and the Orleans Prognostic Test with an r of .61,
2. Orleans' same correlation in 1930 which gathered seventeen r 's ranging from .51 to .80 with an average of .63, and
3. Lee and Hughes' study using the Pol. Res. Bureau Algebra Test and the Lee Aptitude Test with an obtained r of .62.

These figures were higher than the .39 correlation found in this study. One factor to be considered, however, was that the other correlations were made with standard test forms, rather than the local teacher-made examination.

Correlation of algebra grades and I.Q. test. As an aid to interpretation of this correlation, Garrett stated, "the correlation must be .70 or more between measures of general intelligence and school grades. . .to be considered high, since r 's in this field usually run from .40 to .60."¹¹

The coefficient of .38 obtained in the study was below that found in the majority of studies.

Correlation of algebra test and I.Q. test. Similar results of correlations ranging from .40 to .60 were found

¹¹Garrett, loc. cit.

in the correlation of intelligence and the final algebra tests.

Some of these findings were:

1. McCuen study in 1930 of Douglass first semester algebra tests and Terman I.Q. with 116 pupils with a result of .42,
2. Dickter study of the Breslich Algebra Test and the Otis Group I. Q. Test with an r of .54, and
3. Grover's correlation of tests and Terman I.Q. scores with an r of .48.

The r of .46 obtained in this study compared closely with former relationships of like nature.

Correlation of algebra grades and grade eight arithmetic grades. A wide range of coefficients was presented by previous investigators of these variables. Some of these findings were:

1. An r of .14 by French with 114 subjects in 1927,
2. An r of .63 by Kertes in 1932 using first semester marks, and
3. An r of .39 by Ross in 1925 with 134 students involved.

The r of .52 found in this investigation was relatively high as compared with the other findings.

Correlation of algebra test and grade eight arithmetic grades. An r of .48 was obtained in this correlation which is lower than the r of .61 obtained by Dickter in 1933 in correlating the Breslich Algebra Test and eighth grade marks.

Correlation of algebra grades and arithmetic computation. No correlation was found relating grades and arithmetic computation, although Seltzer did correlate semester marks with Courtis Arithmetic Addition and with Courtis Arithmetic Multiplication with scores of .44 and .49 respectively. These coefficients compare closely to the r of .46 in this project.

Correlation of algebra test and arithmetic computation. A study was made by McCuen in 1930 of the relationship of the Douglass First Semester Algebra Tests and Stanford Arithmetic Computation with an r of .36. This study, which involved two hundred students, as compared with forty-eight in the McCuen investigation, gave an r of .57.

Correlation of algebra grades and arithmetic reasoning.

Two studies were made of these variables:

1. Relationship of marks and "ability problems" section of the Otis Test with forty-seven students involved with an r of .68; and
2. The French study of 1927 of marks and the Stanford Achievement Test in arithmetic with an r of .32.

This particular study gave an r of .45.

Correlation of algebra test and arithmetic reasoning.

While this project gave an r of .59, the McCuen correlation

of Douglass First Semester Algebra Test and Stanford Arithmetic Reasoning Test gave an r of .39.

CHAPTER VII

FINAL INTERPRETATION AND CONCLUSIONS

I. GENERAL SUMMARY

Statistical studies employing grades and test results as standards of successful achievement have some limitations. Grades and final examination results do not always give a true index of the learning that has taken place in an individual.

As has been mentioned, the weaker students had not been placed in algebra. Also, the failing students had already dropped the course before the time of receiving the grades and the test scores. This, naturally, made a more homogeneous grouping which, in turn, dropped the correlation coefficient from the r 's that probably would have been achieved with the inclusion of all ninth grade students.

In referring to the general summary made by Douglass, it was stated that success in algebra could be predicted with a fair degree of accuracy only. This statement has been substantiated by the findings in this thesis. The coefficients showed significant, or marked relationships with the success factors in the case of arithmetic reasoning, arithmetic computation, and eighth grade marks. However, in no case was there an r on the range described as a very high relationship.

In the variables of the prognostic test and the intelligence quotient correlations there were some correlations in the range described as low correlations.

Another summarizing statement made was that success in the study of algebra could not be predicted from any one variable alone. As has been noted, none of the correlations were in the high to very high group of correlation coefficients.

This thesis had findings which differed from previous investigations in the relative order of merit of prognostic variables. In this particular study the achievement tests in arithmetic computation and reasoning and the eighth grade marks gave a better relationship with the success factors than did the measurement of algebra aptitude tests and intelligence quotients scores.

This is contrasted to the findings of Douglass which placed prognostic tests as the best single measure of predicting success in algebra, followed by intelligence scores, and then further down the list the achievement test and marks in the previous year's work in mathematics.

In applying this information to the Santa Rosa School System, the recommendation would be to continue the present practice of analyzing all available factors which aid in the predicting of success in algebra, rather than depending to a great extent upon any one prognostic factor.

II. RECOMMENDATIONS FOR FURTHER STUDY

This study revealed a low correlation between the prognostic test and the grades received in algebra as well as the final algebra examination. This r was much lower than the r found in other similar studies. Further study should be made of the value of the Iowa Algebra Aptitude Test. One approach could be to administer half of the students the Iowa Algebra Aptitude Test and the other half of the students another algebra prognostic test. The comparison of the correlation coefficients of the two prognostic tests with the success factors would give additional information about the validity of the Iowa Algebra Aptitude Test.

Another valuable study would be to include in the research all of the students placed in algebra, in contrast to this particular study which included only those students who completed the first semester of the course. With all of the students included, the study could predict chance of success or failure in the study of algebra.

An improvement of this study might have been to relate the success factors to combinations of variables which aid in predicting success in algebra. As the practice has been to place the student according to a judgment of several variables, a study of this nature might have a more valid significance in the improvement of educational placement of students in the Santa Rosa junior high schools.

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APPENDIX

TABLE XIV

RAW SCORES FOR CORRELATION OF ALGEBRA GRADES
AND ALGEBRA TEST

ALGEBRA GRADES		ALGEBRA TEST	ALGEBRA GRADES		ALGEBRA TEST	ALGEBRA GRADES		ALGEBRA TEST	ALGEBRA GRADES		ALGEBRA TEST
X		Y	X		Y	X		Y	X		Y
1.	3	7	51.	4	13	101.	3	5	151.	3	5
2.	4	11	52.	4	13	102.	2	3	152.	5	18
3.	4	12	53.	4	9	103.	4	11	153.	4	7
4.	3	3	54.	4	12	104.	3	5	154.	3	8
5.	3	5	55.	4	5	105.	5	8	155.	2	5
6.	4	13	56.	2	9	106.	5	10	156.	3	2
7.	3	1	57.	3	9	107.	3	3	157.	3	2
8.	4	14	58.	3	14	108.	3	7	158.	5	13
9.	4	4	59.	4	5	109.	3	7	159.	5	14
10.	4	14	60.	5	7	110.	3	7	160.	2	4
11.	4	10	61.	2	1	111.	2	2	161.	4	20
12.	5	18	62.	5	15	112.	4	6	162.	3	3
13.	3	2	63.	4	18	113.	4	9	163.	5	15
14.	3	8	64.	4	17	114.	4	3	164.	3	3
15.	3	4	65.	3	12	115.	4	13	165.	4	9
16.	3	7	66.	5	10	116.	4	7	166.	4	14
17.	3	5	67.	2	4	117.	3	4	167.	5	8
18.	3	3	68.	5	14	118.	3	6	168.	4	3
19.	3	5	69.	5	10	119.	3	6	169.	3	4
20.	5	14	70.	3	6	120.	3	8	170.	3	4
21.	3	4	71.	3	4	121.	4	12	171.	3	5
22.	4	8	72.	3	9	122.	2	4	172.	3	4
23.	3	11	73.	4	12	123.	5	20	173.	4	10
24.	3	5	74.	3	5	124.	5	9	174.	4	4

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TABLE XVI

RAW SCORES FOR CORRELATION OF ALGEBRA TEST RESULTS
AND ALGEBRA PROGNOSTIC TEST

	ALGEBRA GRADES	ALGEBRA PROGNOSIS		ALGEBRA GRADES	ALGEBRA PROGNOSIS		ALGEBRA GRADES	ALGEBRA PROGNOSIS		ALGEBRA GRADES	ALGEBRA PROGNOSIS
	X	Y		X	Y		X	Y		X	Y
1.	7	50	51.	13	30	101.	5	79	151.	5	38
2.	11	91	52.	13	62	102.	3	53	152.	18	65
3.	12	36	53.	9	56	103.	11	56	153.	7	60
4.	3	48	54.	12	44	104.	5	48	154.	8	36
5.	5	58	55.	5	56	105.	8	63	155.	5	36
6.	13	38	56.	9	53	106.	10	58	156.	2	72
7.	1	62	57.	9	60	107.	3	30	157.	2	25
8.	14	75	58.	14	50	108.	7	65	158.	15	76
9.	4	72	59.	5	68	109.	7	53	159.	14	77
10.	14	46	60.	7	76	110.	7	65	160.	4	42
11.	10	74	61.	1	53	111.	2	48	161.	20	74
12.	18	83	62.	15	85	112.	6	60	162.	3	65
13.	2	40	63.	18	93	113.	9	48	163.	15	53
14.	8	65	64.	17	58	114.	3	75	164.	3	29
15.	4	34	65.	12	76	115.	13	93	165.	9	60
16.	3	82	66.	10	72	116.	7	44	166.	14	60
17.	5	62	67.	4	46	117.	4	46	167.	8	74
18.	3	77	68.	14	82	118.	6	50	168.	3	58
19.	5	17	69.	10	79	119.	6	44	169.	4	79
20.	14	93	70.	6	68	120.	8	60	170.	4	34
21.	4	70	71.	4	42	121.	12	40	171.	5	44
22.	8	38	72.	9	40	122.	4	42	172.	4	22
23.	11	50	73.	12	60	123.	20	91	173.	10	13
24.	5	58	74.	5	36	124.	9	50	174.	4	34

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TABLE XVII

RAW SCORES FOR CORRELATION OF ALGEBRA GRADES
AND I.Q. SCORES

	ALGEBRA GRADES X	I.Q. SCORE Y		ALGEBRA GRADES X	I.Q. SCORE Y		ALGEBRA GRADES X	I.Q. SCORE Y		ALGEBRA GRADES X	I.Q. SCORE Y
1.	3	98	51.	4	115	101.	3	103	151.	3	95
2.	4	124	52.	4	108	102.	2	103	152.	5	145
3.	4	108	53.	4	115	103.	4	115	153.	4	106
4.	3	103	54.	4	117	104.	3	92	154.	3	121
5.	3	107	55.	4	97	105.	5	119	155.	2	113
6.	4	113	56.	2	100	106.	5	106	156.	3	110
7.	3	103	57.	3	120	107.	3	100	157.	3	101
8.	4	117	58.	3	116	108.	3	102	158.	5	118
9.	4	112	59.	4	106	109.	3	118	159.	5	123
10.	4	138	60.	5	120	110.	3	114	160.	2	98
11.	4	111	61.	2	102	111.	2	107	161.	4	115
12.	5	113	62.	5	128	112.	4	119	162.	3	113
13.	3	99	63.	4	124	113.	4	129	163.	5	128
14.	3	114	64.	4	118	114.	4	114	164.	3	111
15.	3	125	65.	3	122	115.	4	117	165.	4	108
16.	3	122	66.	5	113	116.	4	99	166.	4	96
17.	3	126	67.	2	106	117.	3	113	167.	5	105
18.	3	114	68.	5	125	118.	3	126	168.	4	121
19.	3	111	69.	5	111	119.	3	101	169.	3	103
20.	5	143	70.	3	110	120.	3	123	170.	3	94
21.	3	110	71.	3	102	121.	4	105	171.	3	114
22.	4	96	72.	3	103	122.	2	114	172.	3	103
23.	3	131	73.	4	114	123.	5	111	173.	4	108
24.	3	217	74.	3	107	124.	5	116	174.	4	118

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TABLE XVIII

RAW SCORES FOR CORRELATION OF ALGEBRA TEST RESULTS
AND I.Q. SCORES

ALGEBRA TEST		I.Q. SCORE	ALGEBRA TEST		I.Q. SCORE	ALGEBRA TEST		I.Q. SCORE	ALGEBRA TEST		I.Q. SCORE
X	Y		X	Y		X	Y		X	Y	
1.	7	98	51.	13	115	101.	5	103	151.	5	95
2.	11	124	52.	13	108	102.	3	103	152.	18	145
3.	12	108	53.	9	115	103.	11	115	153.	7	106
4.	3	103	54.	12	117	104.	5	92	154.	8	121
5.	5	107	55.	5	97	105.	8	119	155.	5	113
6.	13	113	56.	9	100	106.	10	106	156.	2	110
7.	1	103	57.	9	120	107.	3	100	157.	2	101
8.	14	117	58.	14	116	108.	7	102	158.	15	118
9.	4	112	59.	5	106	109.	7	118	159.	14	123
10.	14	138	60.	7	120	110.	7	114	160.	4	98
11.	10	111	61.	1	102	111.	2	107	161.	20	115
12.	18	113	62.	15	128	112.	6	119	162.	3	113
13.	2	99	63.	18	124	113.	9	129	163.	15	128
14.	8	114	64.	17	118	114.	3	114	164.	3	111
15.	4	125	65.	12	122	115.	13	117	165.	9	108
16.	7	122	66.	10	113	116.	7	99	166.	14	96
17.	5	126	67.	4	106	117.	4	113	167.	3	105
18.	3	114	68.	14	125	118.	6	126	168.	3	121
19.	5	111	69.	10	111	119.	6	101	169.	4	103
20.	14	143	70.	6	110	120.	8	123	170.	4	94
21.	4	110	71.	4	102	121.	12	105	171.	5	114
22.	8	96	72.	9	103	122.	4	114	172.	4	103
23.	11	131	73.	12	114	123.	20	111	173.	10	108
24.	5	127	74.	5	107	124.	9	116	174.	4	118

25.	0	99	75.	10	116	125.	10	106	175.	8	126
26.	4	110	76.	11	109	126.	2	96	176.	4	104
27.	3	111	77.	10	105	127.	14	126	177.	4	99
28.	13	136	78.	4	135	128.	2	108	178.	2	79
29.	2	114	79.	7	109	129.	7	123	179.	2	92
30.	5	100	80.	1	88	130.	11	111	180.	5	110
31.	2	106	81.	6	106	131.	9	114	181.	6	119
32.	1	98	82.	10	115	132.	10	131	182.	3	113
33.	6	113	83.	2	98	133.	2	110	183.	9	119
34.	10	113	84.	9	117	134.	12	105	184.	6	104
35.	6	110	85.	9	117	135.	11	100	185.	6	105
36.	7	101	86.	5	117	136.	19	130	186.	7	121
37.	1	100	87.	3	98	137.	2	103	187.	7	103
38.	16	123	88.	11	100	138.	7	128	188.	3	116
39.	8	134	89.	2	108	139.	6	105	189.	3	105
40.	13	134	90.	2	102	140.	7	104	190.	9	112
41.	10	102	91.	2	102	141.	7	109	191.	9	120
42.	3	109	92.	8	114	142.	8	89	192.	7	96
43.	4	107	93.	9	116	143.	9	117	193.	2	117
44.	12	119	94.	7	115	144.	9	124	194.	8	129
45.	5	120	95.	7	111	145.	13	124	195.	4	95
46.	16	111	96.	1	113	146.	10	117	196.	8	123
47.	2	105	97.	6	107	147.	6	101	197.	7	110
48.	4	110	98.	9	103	148.	4	115	198.	8	122
49.	7	111	99.	10	127	149.	14	117	199.	8	109
50.	7	99	100.	13	108	150.	12	106	200.	10	125

TABLE XIX

RAW SCORES FOR CORRELATION OF ALGEBRA GRADES
AND ARITHMETIC GRADES

ALGEBRA GRADES	ARITHMETIC GRADES	ALGEBRA GRADES	ARITHMETIC GRADES	ALGEBRA GRADES	ARITHMETIC GRADES	ALGEBRA GRADES	ARITHMETIC GRADES
X	Y	X	Y	X	Y	X	Y
1.	3	51.	4	101.	3	151.	3
2.	4	52.	4	102.	2	152.	5
3.	4	53.	4	103.	4	153.	4
4.	3	54.	4	104.	3	154.	3
5.	3	55.	4	105.	5	155.	2
6.	4	56.	2	106.	5	156.	3
7.	3	57.	3	107.	3	157.	3
8.	4	58.	3	108.	3	158.	5
9.	4	59.	4	109.	3	159.	5
10.	4	60.	5	110.	3	160.	2
11.	4	61.	2	111.	2	161.	4
12.	5	62.	5	112.	4	162.	3
13.	3	63.	4	113.	4	163.	5
14.	3	64.	4	114.	4	164.	3
15.	3	65.	3	115.	4	165.	4
16.	3	66.	5	116.	4	166.	4
17.	3	67.	3	117.	3	167.	5
18.	3	68.	5	118.	3	168.	4
19.	3	69.	5	119.	3	169.	3
20.	5	70.	3	120.	3	170.	3
21.	3	71.	3	121.	4	171.	3
22.	4	72.	3	122.	3	172.	3
23.	3	73.	4	123.	5	173.	4
24.	3	74.	3	124.	5	174.	4

TABLE XXI

RAW SCORES FOR CORRELATION OF ALGEBRA GRADES
AND ARITHMETIC COMPUTATION TEST

ALGEBRA		ARITHMETIC	ALGEBRA		ARITHMETIC	ALGEBRA		ARITHMETIC	ALGEBRA		ARITHMETIC
GRADE		COMP.	GRADE		COMP.	GRADE		COMP.	GRADE		COMP.
X		Y	X		Y	X		Y	X		Y
1.	3	7.9	51.	4	11.4	101.	3	9.6	151.	3	7.0
2.	4	11.1	52.	4	11.1	102.	2	9.6	152.	3	11.4
3.	4	10.4	53.	4	9.2	103.	4	8.1	153.	4	10.0
4.	3	7.9	54.	4	10.4	104.	3	7.0	154.	3	6.4
5.	3	8.9	55.	4	10.0	105.	5	11.4	155.	2	10.0
6.	4	10.7	56.	2	8.4	106.	5	8.9	156.	3	8.4
7.	3	7.9	57.	3	12.0	107.	3	7.2	157.	3	6.9
8.	4	8.6	58.	3	10.7	108.	3	7.9	158.	5	11.4
9.	4	7.8	59.	4	10.4	109.	3	10.0	159.	5	10.7
10.	4	11.4	60.	5	11.7	110.	3	9.2	160.	2	5.3
11.	4	10.7	61.	2	7.6	111.	2	8.9	161.	4	10.7
12.	5	11.1	62.	5	10.7	112.	4	10.7	162.	3	8.1
13.	3	8.1	63.	4	10.7	113.	4	10.0	163.	5	11.1
14.	3	9.6	64.	4	10.4	114.	4	5.1	164.	3	10.0
15.	3	7.9	65.	3	11.1	115.	4	10.4	165.	4	9.2
16.	3	9.2	66.	5	11.1	116.	4	7.4	166.	4	8.4
17.	3	7.4	67.	2	6.7	117.	3	10.0	167.	5	7.6
18.	3	8.9	68.	5	12.0	118.	3	9.6	168.	4	10.0
19.	3	8.6	69.	5	10.7	119.	3	7.2	169.	3	8.6
20.	5	11.7	70.	3	8.1	120.	3	9.6	170.	3	8.6
21.	3	10.7	71.	3	8.9	121.	4	8.9	171.	3	8.6
22.	4	8.6	72.	3	7.8	122.	2	8.6	172.	3	7.0
23.	3	11.7	73.	4	11.7	123.	5	11.1	173.	4	10.0
24.	3	8.9	74.	3	6.6	124.	5	10.7	174.	4	7.8

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8.9 75.
9.6 76.
8.1 77.
10.0 78.
10.4 79.
8.4 80.
8.6 81.
6.4 82.
9.2 83.
10.0 84.
10.4 85.
7.4 86.
8.4 87.
10.7 88.
8.1 89.
11.4 90.
12.0 91.
7.8 92.
7.8 93.
12.0 94.
8.6 95.
11.1 96.
7.4 97.
7.8 98.
8.9 99.
10.4 100.

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7.9 125.
8.9 126.
8.4 127.
10.0 128.
11.1 129.
8.9 130.
8.6 131.
10.7 132.
7.9 133.
11.7 134.
8.4 135.
11.1 136.
9.2 137.
8.1 138.
6.9 139.
7.8 140.
11.1 141.
10.7 142.
7.8 143.
7.6 144.
8.4 145.
8.6 146.
8.4 147.
7.2 148.
11.7 149.
11.4 150.

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10.0 175.
6.7 176.
11.1 177.
8.9 178.
9.2 179.
8.9 180.
10.0 181.
10.9 182.
11.1 183.
10.0 184.
11.4 185.
11.7 186.
9.6 187.
11.1 188.
6.1 189.
8.9 190.
8.1 191.
8.9 192.
7.9 193.
11.1 194.
11.4 195.
10.0 196.
8.4 197.
7.2 198.
11.4 199.
10.7 200.

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TABLE XXII

RAW SCORES FOR CORRELATION OF ALGEBRA TEST RESULTS
AND ARITHMETIC COMPUTATION SCORES

	ALGEBRA TEST	ARITHMETIC COMP.	ALGEBRA TEST	ARITHMETIC COMP.	ALGEBRA TEST	ARITHMETIC COMP.	ALGEBRA TEST	ARITHMETIC COMP.		
	X	Y	X	Y	X	Y	X	Y		
1.	7	7.9	51.	13	11.4	101.	5	9.6		
2.	11	11.1	52.	13	11.1	102.	3	9.6		
3.	12	10.4	53.	9	9.2	103.	11	8.1		
4.	3	7.9	54.	12	10.4	104.	5	7.0		
5.	5	8.9	55.	5	10.0	105.	8	11.4		
6.	13	10.7	56.	9	8.4	106.	10	8.9		
7.	1	7.9	57.	9	12.0	107.	3	7.2		
8.	14	8.6	58.	14	10.7	108.	7	7.9		
9.	4	7.8	59.	5	10.4	109.	7	10.0		
10.	14	11.4	60.	7	11.7	110.	7	9.2		
11.	10	10.7	61.	1	7.6	111.	2	8.9		
12.	18	11.1	62.	15	10.7	112.	6	10.7		
13.	2	8.1	63.	18	10.7	113.	9	10.0		
14.	8	9.6	64.	17	10.4	114.	3	5.1		
15.	4	7.9	65.	12	11.1	115.	13	10.4		
16.	7	9.2	66.	10	11.1	116.	7	7.4		
17.	5	7.4	67.	4	6.7	117.	4	10.0		
18.	3	8.9	68.	14	12.0	118.	6	9.6		
19.	5	8.6	69.	10	10.7	119.	6	7.2		
20.	14	11.7	70.	6	8.1	120.	8	9.6		
21.	4	10.7	71.	4	8.9	121.	12	8.9		
22.	8	8.6	72.	9	7.8	122.	4	8.6		
23.	11	11.7	73.	12	11.7	123.	20	11.1		
24.	5	8.9	74.	5	6.6	124.	9	10.7		
								151.	5	7.0
								152.	18	11.4
								153.	7	10.0
								154.	8	6.4
								155.	5	10.0
								156.	2	8.4
								157.	2	6.9
								158.	15	11.4
								159.	14	10.7
								160.	4	5.3
								161.	20	10.7
								162.	3	8.1
								163.	15	11.1
								164.	3	10.0
								165.	9	9.2
								166.	14	8.4
								167.	8	7.6
								168.	3	10.0
								169.	4	8.6
								170.	4	8.6
								171.	5	8.6
								172.	4	7.0
								173.	10	10.0
								174.	4	7.8

25.	0	8.9	75.	10	7.9	125.	10	10.0	175.	8	10.7
26.	4	9.6	76.	11	8.9	126.	2	6.7	176.	4	7.2
27.	3	8.1	77.	10	8.4	127.	14	11.1	177.	4	9.6
28.	13	10.0	78.	4	10.0	128.	2	8.9	178.	2	8.1
29.	2	10.4	79.	7	11.1	129.	7	9.2	179.	2	6.2
30.	5	8.4	80.	1	8.9	130.	11	8.9	180.	5	6.7
31.	2	8.6	81.	6	8.6	131.	9	10.0	181.	6	7.4
32.	1	6.4	82.	10	10.7	132.	10	10.9	182.	3	10.0
33.	6	9.2	83.	2	7.9	133.	2	11.1	183.	9	10.4
34.	10	10.0	84.	9	11.7	134.	12	10.0	184.	6	7.8
35.	6	10.4	85.	9	8.4	135.	11	11.4	185.	6	10.0
36.	7	7.4	86.	5	11.1	136.	19	11.7	186.	7	7.9
37.	1	8.4	87.	3	9.2	137.	2	9.6	187.	7	7.9
38.	16	10.7	88.	11	8.1	138.	7	11.1	188.	3	8.6
39.	8	8.1	89.	2	6.9	139.	6	8.1	189.	3	8.6
40.	13	11.4	90.	2	7.8	140.	7	8.9	190.	9	7.9
41.	10	12.0	91.	2	11.1	141.	7	8.1	191.	9	7.4
42.	3	7.8	92.	8	10.7	142.	8	8.9	192.	7	7.6
43.	4	7.8	93.	9	7.8	143.	9	7.9	193.	2	8.1
44.	12	12.0	94.	7	7.6	144.	9	11.1	194.	8	8.9
45.	5	8.6	95.	7	8.4	145.	13	11.4	195.	4	7.4
46.	16	11.1	96.	1	8.6	146.	10	10.0	196.	8	11.7
47.	2	7.4	97.	6	8.4	147.	6	8.4	197.	7	10.0
48.	4	7.8	98.	9	7.2	148.	4	7.2	198.	8	8.1
49.	7	8.9	99.	10	11.7	149.	14	11.4	199.	8	9.6
50.	7	10.4	100.	13	11.4	150.	12	10.7	200.	10	10.7

TABLE XXIII

RAW SCORES FOR CORRELATION OF ALGEBRA GRADES
AND ARITHMETIC REASONING TEST

	ALGEBRA GRADE	ARITHMETIC REASONING		ALGEBRA GRADE	ARITHMETIC REASONING		ALGEBRA GRADE	ARITHMETIC REASONING		ALGEBRA GRADE	ARITHMETIC REASONING
	X	Y		X	Y		X	Y		X	Y
1.	3	6.7	51.	4	8.6	101.	3	10.7	151.	3	6.9
2.	4	10.4	52.	4	11.7	102.	2	9.8	152.	5	12.7
3.	4	10.1	53.	4	10.7	103.	4	10.4	153.	4	10.4
4.	3	6.3	54.	4	11.0	104.	3	7.1	154.	3	10.4
5.	3	10.1	55.	4	8.9	105.	5	11.7	155.	2	10.4
6.	4	12.0	56.	2	9.5	106.	5	8.4	156.	3	6.3
7.	3	6.5	57.	3	12.3	107.	3	7.3	157.	3	6.3
8.	4	10.7	58.	3	12.0	108.	3	9.5	158.	5	11.7
9.	4	8.9	59.	4	9.5	109.	3	9.8	159.	5	12.0
10.	4	12.0	60.	5	12.3	110.	3	8.9	160.	2	6.3
11.	4	10.7	61.	2	7.7	111.	2	8.9	161.	4	12.0
12.	5	12.3	62.	5	11.7	112.	4	12.0	162.	3	9.8
13.	3	9.2	63.	4	12.7	113.	4	10.7	163.	5	12.7
14.	3	9.8	64.	4	11.7	114.	4	11.0	164.	3	8.6
15.	3	10.1	65.	3	10.7	115.	4	12.0	165.	4	9.8
16.	3	10.1	66.	5	10.7	116.	4	7.7	166.	4	7.7
17.	3	8.1	67.	2	7.9	117.	3	9.8	167.	5	9.5
18.	3	10.1	68.	5	12.7	118.	3	11.7	168.	4	9.8
19.	3	8.6	69.	5	12.3	119.	3	10.1	169.	3	6.0
20.	5	12.3	70.	3	9.8	120.	3	12.3	170.	3	8.9
21.	3	11.0	71.	3	7.9	121.	4	8.9	171.	3	8.4
22.	4	8.6	72.	3	8.1	122.	2	11.3	172.	3	6.7
23.	3	11.0	73.	4	11.7	123.	5	11.7	173.	4	10.1
24.	3	11.7	74.	3	7.3	124.	5	10.1	174.	4	7.3

25.	2	8.6	75.	3	9.8	125.	3	10.4	175.	3	11.3
26.	4	9.5	76.	3	11.0	126.	2	7.7	176.	3	7.5
27.	3	8.1	77.	4	9.5	127.	5	11.7	177.	4	8.6
28.	5	10.4	78.	3	12.3	128.	3	9.5	178.	3	8.9
29.	3.	8.4	79.	3	8.6	129.	3	11.3	179.	3	5.0
30.	3	7.1	80.	3	8.6	130.	3	8.6	180.	4	8.9
31.	2	10.7	81.	3	7.7	131.	4	8.9	181.	4	10.1
32.	2	9.5	82.	3	12.3	132.	3	10.1	182.	3	7.5
33.	2	9.8	83.	2	7.5	133.	3	9.8	183.	4	10.4
34.	3	9.2	84.	3	11.0	134.	5	12.0	184.	3	7.3
35.	5	9.5	85.	3	9.5	135.	3	10.4	185.	3	6.8
36.	3	8.4	86.	4	10.4	136.	5	11.7	186.	5	10.4
37.	2	7.9	87.	4	8.9	137.	3	9.8	187.	4	7.3
38.	5	9.8	88.	3	8.6	138.	3	12.0	188.	3	8.6
39.	3	10.4	89.	3	9.8	139.	3	8.9	189.	3	10.1
40.	5	12.3	90.	3	7.5	140.	3	8.9	190.	4	7.9
41.	4	11.0	91.	3	9.2	141.	3	7.9	191.	5	9.5
42.	3	9.5	92.	3	12.0	142.	4	10.7	192.	3	7.1
43.	2	7.7	93.	4	8.9	143.	4	8.9	193.	2	8.4
44.	4	12.0	94.	3	7.3	144.	4	12.0	194.	4	11.0
45.	4	9.2	95.	4	9.5	145.	5	11.7	195.	3	5.8
46.	5	12.3	96.	3	11.3	146.	2	7.9	196.	4	12.3
47.	2	7.7	97.	2	9.5	147.	3	9.5	197.	5	9.8
48.	3	7.9	98.	3	9.2	148.	2	8.6	198.	3	9.5
49.	3	7.3	99.	5	10.4	149.	4	12.7	199.	5	11.3
50.	4	8.1	100.	3	12.3	150.	3	11.7	200.	4	11.0

TABLE XXIV

RAW SCORES FOR CORRELATION OF ALGEBRA TEST RESULTS
AND ARITHMETIC REASONING TEST

ALGEBRA TEST		ARITHMETIC REASONING		ALGEBRA TEST		ARITHMETIC REASONING		ALGEBRA TEST		ARITHMETIC REASONING	
X	Y	X	Y	X	Y	X	Y	X	Y		
1.	7	6.7	51.	13	8.6	101.	5	10.7	151.	5	6.9
2.	11	10.4	52.	13	11.7	102.	3	9.8	152.	18	12.7
3.	12	10.1	53.	9	10.7	103.	11	10.4	153.	7	10.4
4.	3	6.3	54.	12	11.0	104.	5	7.1	154.	8	10.4
5.	5	10.1	55.	5	8.9	105.	8	11.7	155.	5	10.4
6.	13	12.0	56.	9	9.5	106.	10	8.4	156.	2	6.3
7.	1	6.5	57.	9	12.3	107.	3	7.3	157.	2	6.3
8.	14	10.7	58.	14	12.0	108.	7	9.5	158.	15	11.7
9.	4	8.9	59.	5	9.5	109.	7	9.8	159.	14	12.0
10.	14	12.0	60.	7	12.3	110.	7	8.9	160.	4	6.3
11.	10	10.7	61.	1	7.7	111.	2	8.9	161.	20	12.0
12.	18	12.3	62.	15	11.7	112.	6	12.0	162.	3	9.8
13.	2	9.2	63.	13	12.7	113.	9	10.7	163.	15	12.7
14.	8	9.8	64.	17	11.7	114.	3	11.0	164.	3	8.6
15.	4	10.1	65.	12	10.7	115.	13	12.0	165.	9	9.8
16.	7	10.1	66.	10	10.7	116.	7	7.7	166.	14	7.7
17.	5	8.1	67.	4	7.9	117.	4	9.8	167.	8	9.5
18.	3	10.1	68.	14	12.7	118.	6	11.7	168.	3	9.8
19.	5	8.6	69.	10	12.3	119.	6	10.1	169.	4	6.0
20.	14	12.3	70.	6	9.8	120.	8	12.3	170.	4	8.9
21.	4	11.0	71.	4	7.9	121.	12	8.9	171.	5	8.4
22.	8	8.6	72.	9	8.1	122.	4	11.3	172.	4	6.7
23.	11	11.0	73.	12	11.7	123.	20	11.7	173.	10	10.1
24.	5	11.7	74.	5	7.3	124.	9	10.1	174.	4	7.3

25.	0	8.6	75.	10	9.8	125.	10	10.4	175.	8	11.3
26.	4	9.5	76.	11	11.0	126.	2	7.7	176.	4	7.5
27.	3	8.1	77.	10	9.5	127.	14	11.7	177.	4	8.6
28.	13	10.4	78.	4	12.3	128.	2	9.5	178.	2	8.9
29.	2	8.4	79.	7	8.6	129.	7	11.3	179.	2	5.0
30.	5	7.1	80.	1	8.6	130.	11	8.6	180.	5	8.9
31.	2	10.7	81.	6	7.7	131.	9	8.9	181.	6	10.1
32.	1	9.5	82.	10	12.3	132.	10	10.1	182.	3	7.5
33.	6	9.8	83.	2	7.5	133.	2	9.8	183.	9	10.4
34.	10	9.2	84.	9	11.0	134.	12	12.0	184.	6	7.3
35.	6	9.5	85.	9	9.5	135.	11	10.4	185.	6	6.8
36.	7	8.4	86.	5	10.4	136.	19	11.7	186.	7	10.4
37.	1	7.9	87.	3	8.9	137.	2	9.8	187.	7	7.3
38.	16	9.8	88.	11	8.6	138.	7	12.0	188.	3	8.6
39.	8	10.4	89.	2	9.8	139.	6	8.9	189.	3	10.1
40.	13	12.3	90.	2	7.5	140.	7	8.9	190.	9	7.9
41.	10	11.0	91.	2	9.2	141.	7	7.9	191.	9	9.5
42.	3	9.5	92.	8	12.0	142.	8	10.7	192.	7	7.1
43.	4	7.7	93.	9	8.9	143.	9	8.9	193.	2	8.4
44.	12	12.0	94.	7	7.3	144.	9	12.0	194.	8	11.0
45.	5	9.2	95.	7	9.5	145.	13	11.7	195.	4	5.8
46.	16	12.3	96.	1	11.3	146.	10	7.9	196.	8	12.3
47.	2	7.7	97.	6	9.5	147.	6	9.5	197.	7	9.8
48.	4	7.9	98.	9	9.2	148.	4	8.6	198.	8	9.5
49.	7	7.3	99.	10	10.4	149.	14	12.7	199.	8	11.3
50.	7	8.1	100.	13	12.3	150.	12	11.7	200.	10	11.0