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A Comparison of the Iowa Tests of Educational Development with Student Achievement as Predictors of Future Student Success in Mathematics

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A COMPARISON OF THE IOWA TESTS OF EDUCATIONAL DEVELOPMENT WITH STUDENT ACHIEVEMENT AS PREDICTORS OF FUTURE STUDENT SUCCESS IN MATHEMATICS

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CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

The guidance program of Eastmont School District numbers among its goals, objective student appraisal and has administered, since 1960, the Iowa Tests of Educational Development (here after referred to as the ITED) to all freshmen and transfer students.

Continued research is necessary on tests used at this level to provide information that will make the test results increasingly useful. The investigator has chosen to study the ITED in order to provide additional empirical information concerning its specific usefulness in relation to courses in mathematics at Eastmont High School.

I. THE PROBLEM

Statement of the problem

It was the purpose of this study (1) to compare ninth grade algebra grades with grades achieved in future mathematics courses; (2) to compare scores achieved on the ITED with grades achieved in future mathematics courses; and (3) to determine whether the ITED or past student achievement was the better predictor of future student success in mathematics.

Importance of the study

Many studies have been published on the validity of the ITED and other tests at different high schools, colleges, and universities. However, one has not been carried on at Eastmont High School.

The hope of the investigator is that the information presented in this study will be used by the counselors at Eastmont High School toward more specific use and interpretation of the ITED scores and previous mathematics grades when predicting student achievement in subsequent mathematics courses.

II. DEFINITIONS OF TERMS USED

ITED. Iowa Tests of Educational Development.

Percentile. Comparative ranking with other students. A student with a ranking of 75th percentile is higher than seventy-four per cent of all others tested.

Quantitative thinking score. The standard score, given as a percentile, on that part of the ITED dealing with mathematical ability.

Composite score. The standard score, given as a percentile, which is found by taking the sum of all the scores on the individual sections of the ITED and converting it to a standard score.

III. ORGANIZATION OF REMAINDER OF THE THESIS

The present chapter identifies and states the problem. Chapter II will contain a review of related literature. The methods and procedure used to collect the data are reported in Chapter III. Chapter IV presents an analysis of the findings of the study, and Chapter V gives the summary and conclusions.

CHAPTER II

REVIEW OF THE LITERATURE

Numerous studies of grade prediction in colleges using standardized tests have been completed but little seems to have been done in the area of attempting to predict mathematics grades on the high school level.

Some schools administer prognostic tests for algebra or foreign language to aid in making the decision as to what courses a student should take. Regardless of scores on these tests some pupils with higher scores will fail the course and some with lower scores will succeed. Usually other indices are used. Achievement in eighth grade mathematics and exploratory language courses is indicative of success or failure in subsequent courses. In addition, teacher's recommendations should be solicited and considered (8:190).

R. C. Woellner stated that regardless of how conscientiously counselors endeavor to make scientific interpretations of test profiles, the use of standardized tests in counseling can never be reduced to a mechanical routine (20:516).

In his study on test interpretation in the high school guidance program McCabe indicated there was no relationship between high school grades and subsequent

college grades for students in the 100-120 range on the Terman-McNemar IQ scores. There was also no relationship between Terman-McNemar scores and subsequent grades in college for the same group of students. An important exception was that none of these students obtained a grade point average above 2.1 (in a three point system in which A is 3, B is 2, and C is 1). The relationship between high school grades and subsequent college grades in the 121-140 IQ range was quite definite. The relationship was also apparent above 140 IQ (10:450).

McCabe summarized by recommending that further study be made to determine the relationship between grades in specific kinds of courses in high school and grades in specific programs in colleges (10:450-51).

Roland G. Ross, in a study of trends in guidance, related information on reports from 42 state and territorial supervisors of guidance. Responses to several items considered were as follows (15:14):

> Schools are doing more specific planning for the use of test results in instruction, diagnosis and grade placement.
>
> Yes 29 No 4 Uncertain 9
>
> Test results help the school's staff to help the student plan his career and select his courses.
>
> Yes 38 No 2 Uncertain 2 (15:14)

In a study made by Bromily and Carter on the predic-

tability of success in mathematics at the University of Illinois a correlation was determined between grades achieved in mathematics and the following tests.

1. Cooperative General Achievement Test, Test III.
2. American Council of Education Psychological Examination.
3. Van Wagenen and Dvorak Diagnostic Examination of silent reading abilities.

A correlation was also found between the grades achieved and rank in high school graduating class. The coefficients of correlation were computed by the Pearson product-moment method. These are shown in Table I (4:149).

TABLE I

COEFFICIENTS OF CORRELATION WITH AVERAGE GRADES IN COLLEGE MATHEMATICS

	r
Cooperative General Achievement Test, Test III	
Total Score	.35
Mathematics Comprehension Score	.32
American Council of Education Psychological Examination	
Total Score	.24
Quantitative Score	.28
Linguistic Score	.16
Van Wagenen Examination of Silent Reading Abilities	
Total Score	.11
Rank in high school	.40

The highest correlation found was that between rank in high school and average grades in college mathematics (4:149).

The coefficient of correlation was employed by Yule in his study of the relationship between sixth grade School and College Ability Test and the eighth grade Sequential Test of Educational Progress. He found a Coefficient of Correlation r of .76 for male students and .79 for females (22:11).

Young used one hundred eleven sophomores for her sample for whom all the criterion and predictive data were available. Young was trying to determine how well the Washington Pre-College Differential Grade Prediction Battery actually predicted the grades of students at Central Washington College of Education. She found a correlation of .77 between the predicted grade point average and the earned grade point average after five quarters work (21:35).

The concept of predictability seems to offer considerable promise for both testing and counseling according to Tolbert. He suggests that a clinician in some cases may be more accurate with certain types of persons than statistical prediction (18:219).

In an honors mathematics class taken by twenty-three outstanding high school mathematics students at Southern State College of Magnolia, Arkansas, the results shown in Table II and Table III were found. These tables were taken directly from the source (6:565).

TABLE II

CORRELATION BETWEEN MATHEMATICS TEST SCORES AND COURSE GRADE*

Course Grade	National Percentile of Standardized Tests (mathematics)				
	80	85	90	95	100
A			# $		## $# $* @
B			* # * $	X	#* # $ ¢
C				$	** $# # *¢
F					

*SRA NEDT Math., #; PSAT Math., $; Iowa Quant., *; Steck Fund. Eval. Math., @; Calif. Math., ¢; Coop. School and College Ability in Math., X (6:565).

In this table the national percentile obtained on standardized tests taken by each student is compared to the course grade achieved by the student who obtained that score.

TABLE III

CORRELATION BETWEEN HIGH SCHOOL GRADES AND COURSE GRADES*

Course Grade	Lowest Grade Received in High School			
	D	C	B	A
A			4	4
B		1	7	1
C	1	2	2	
F	1			

*Numbers indicate number of students in each category.

High school grades were the most indicative of all the criteria insofar as ultimate success was concerned. Students with lesser abilities as shown by test scores, who sometimes achieved well in high school were unable to equal the successful high-ability students. It was the high-ability students who had achieved poorly in high school who were the most disappointing of the training program participants (6:565).

Grossman stated that if this program were offered again, the director would first evaluate participants on actual achievement as measured by high school grades. Grossman summarized by saying that achievement tests and intelligence tests show ability potential; grades show utilization of that potential (6:560-566).

Thresher states, "But we now have more than half a century of experience to show that standardized tests, properly used in conjunction with school records, make possible a better selection than school records alone." He also suggests that test scores may be affected by anxiety in some persons while others may be inhibited by it (17:17).

Douglass discussed the fact that young people today are under great stress to succeed in school and score high on tests. He states that many thousands of youngsters have had some sort of mental breakdown, and have had to be treated by psychiatrists. He states that coefficients of correlation between a combination of test scores and rank in class or average grade or honor-point ratio in high school almost always has been between .55 and .65 (5:392).

In interpreting "r", Balsley gives the following ratings of correlation coefficients. For purposes of this study, these ratings will be the ones used. These are: (1) if the correlation coefficient (r) is greater than .90,

a high degree of correlation exists; (2) a correlation coefficient between .80 and .90 is considered "good" correlation; (3) a correlation coefficient ranging from .60 to .80 indicates that some degree of correlation is probably present; (4) a correlation coefficient above .30 and up to .60 indicates that there is some slight possibility of correlation; (5) a correlation coefficient of .30 or less indicates no relationship between the variables and therefore no correlation. These groupings are approximate and vary from ones established by other authors but should serve to give an idea of the degree of correlation found in this study (2:184).

Material presented in this chapter indicates that student achievement is more indicative of future success than results of standardized tests. In some instances standardized test scores and future success have a fairly high correlation but they always seem to be lower than correlations found between grades and future achievement. Some authors feel that the answer to prediction lies in a combination of standardized test scores and student achievement.

CHAPTER III

MATERIALS USED AND GROUPS STUDIED

Predictive devices

The ITED. The ITED is a battery of nine objective tests designed to provide a comprehensive and dependable description of the general educational development of the high school student. The individual tests in the battery are as follows:

1. Understanding of Basic Social Concepts.
2. General Background in the Natural Sciences.
3. Correctness and Appropriateness of Expression.
4. Ability to do Quantitative Thinking.
5. Ability to Interpret Reading Materials in the Social Studies.
6. Ability to Interpret Reading Materials in the Natural Sciences.
7. Ability to Interpret Literary Materials.
8. General Vocabulary.
9. Use of Sources of Information.

These tests are designed to measure relatively broad and generalized intellectual skills and abilities that are continuously developed in every student. These tests may be given to any high school student in any grade regardless of classes taken (9:3-8).

The major purposes of the tests were: (1) to help

adapt instruction and guidance to each student's unique and changing needs, and (2) to help in making a more dependable and objective evaluation of the total educational offerings of the school (9:1).

The scores which will be used in this study are the scores from Test 4 and the Composite Score.

Previous mathematics grades. These data will be obtained directly from the instructor's grade books since only the letter grades are entered on the permanent records. Numerical grades will be used since it provides for a more complete ranking than letter grades. The sum of the tests given during each semester will be derived by combining each student's numerical test scores. Each student's total will be divided by the number of tests given to determine his average.

The study sample

The study sample will be the students who were enrolled in ninth grade mathematics classes at Vivian M. Sterling Junior High School during the school year 1963-64. The study will be concerned with only those students who have ITED scores available and who completed ninth grade algebra.

CHAPTER IV

TECHNIQUES AND RESULTS OF THE INDIVIDUAL EXPERIMENTS

I. TREATMENT OF THE DATA

The first step taken in the study was to obtain a list of all students who completed ninth grade algebra in the school year 1963-64. This was taken directly from the teacher's grade book. The same teacher instructed every ninth grade algebra class. All students had the same teacher at every grade level which makes the study a little more meaningful.

Quantitative thinking and Composite scores were then obtained for all of these students from the permanent record files of Eastmont High School. Any student who did not have these scores available was eliminated from the study. The next step was to compute each student's grade average for each semester he remained in the mathematics sequence. There were one-hundred and one students who had met the criterion of completing ninth grade algebra and who had ITED scores available. There were seventy of these who continued on with geometry in the tenth grade. As juniors there were thirty-eight remaining and as seniors in trigonometry and mathematics analysis there were twenty-two.

The quantitative thinking and composite scores for each student remaining at each grade level were separated

from the original list of one-hundred and one for purposes of deriving coefficients of correlation. Test averages from the first semester of ninth grade algebra for each student remaining at each grade level were also separated from the original list for the same purpose.

A coefficient of correlation was then found between the test average from the first semester of ninth grade algebra and each subsequent semester for those students remaining in the program. Coefficients of correlation were found between the students left in each semester and the quantitative thinking scores and the composite scores they had obtained on their tests taken in the ninth grade. These coefficients of correlation were found by using the following formula:

$$r = \frac{\Sigma xy}{N \sigma x \sigma y}$$

An example of the technique used is found in Appendix B.

II. RESULTS OF THE INDIVIDUAL EXPERIMENTS

The results of the correlations are found in Table IV.

TABLE IV

COEFFICIENTS OF CORRELATION BETWEEN EACH GRADE LEVEL AND QUANTITATIVE THINKING AND COMPOSITE SCORE ON THE ITED AND AVERAGE ON TESTS IN 9-1*

Semester	Number of Students	Correlation with Quantitative Score	Correlation with Composite Score	Correlation with test average in 9-1
9-1	101	.64	.48	1.00
9-2	101	.58	.43	.82
10-1	70	.58	.53	.69
10-2	70	.50	.46	.63
11-1	38	.47	.47	.71
11-2	38	.41	.52	.64
12-1	22	.42	.49	.87
12-2	22	.38	.41	.66

*In the column headed semester, the first number in each case refers to the year in school and the second number refers to the semester of that year.

It was found by the investigator that correlations between the quantitative thinking scores and test averages for each semester throughout the sequence declined at each level. The correlation between the quantitative thinking score and the first semester average in ninth grade algebra was .64 which shows some degree of correlation but subsequent correlations grew less each semester until it dropped to .38 for the final semester of twelfth grade mathematics.

In contrast to the correlations found with the quantitative thinking scores, the composite scores seem to give the same correlation throughout the mathematics sequence with some fluctuation. It should be noted that there was a slightly higher correlation between the composite score and the average in tenth grade geometry than there was when correlating it to ninth or eleventh grade algebra. It should also be noted that there was a higher correlation between the composite score and eleventh grade algebra than with ninth grade algebra.

Although the correlation declines each semester, the correlation between the average obtained in the first semester of ninth grade algebra and each subsequent semester was statistically significant. The highest degree of correlation was that between the ninth grade test average and the first semester test average in the twelfth grade which was trigonometry. This high correlation might be explained by

the fact that trigonometry involves a great deal of material which must be memorized as does the first semester of ninth grade algebra. They are both subjects in which you must learn certain axioms, principles, and methods which are used later in problem solving. This and the mechanical processes by which certain problems are solved might explain such a high correlation.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

This study found that although much work has been done in trying to predict success or failure in college through the use of tests, not much has been done to try to predict success in high school. Testing at the high school level has been primarily concerned with determining the level of development students have attained. By conducting this study, the investigator hoped to discover whether the Iowa Tests of Educational Development would enable counselors at the high school level to recommend whether or not students should proceed in the sequence of mathematics courses beyond the ninth grade level.

In reviewing similar studies, it was found that previous grades appeared to provide a better indication of how a student would succeed than the results of previous standardized tests.

In this study, correlations were computed between success in the first semester of ninth grade algebra and subsequent mathematics classes. Correlations were also computed between the quantitative thinking and composite scores on the ITED and subsequent mathematics classes.

The correlations between average grades in the first semester of ninth grade algebra and subsequent mathematics classes declined from .82 in the second semester of the ninth grade to .66 for the second semester of twelfth grade mathematics. It should be noted that the correlation between ninth grade algebra and eleventh grade algebra was higher than that between ninth grade algebra and tenth grade geometry. The correlation between ninth grade algebra and twelfth grade trigonometry, which is studied the first semester, was the highest correlation, .87, obtained in the entire study.

Correlations computed between the composite scores achieved on the ITED and subsequent mathematics grades remained almost constant throughout high school. None were significant statistically but it was interesting to note that in the eleventh and twelfth grades there was a closer correlation between mathematics grades and composite scores than between mathematics grades and quantitative thinking scores. The correlation between the composite scores and test averages for the second semester of eleventh grade algebra was the only instance in the study where a higher correlation was found the second semester than was found the first semester.

Other than predictions by grades, the correlations between the quantitative thinking scores and the first and

second semester of ninth grade algebra and the first semester of tenth grade geometry were the only ones which were significant.

II. CONCLUSIONS

The results of this study indicate that counselors should carefully consider achievement in past courses when attempting to predict success or failure for a student in future mathematics classes. The high correlation found between algebra test averages and trigonometry test averages might indicate that success in trigonometry could be predicted successfully. It could also suggest that trigonometry would be better placed in the sequence if second year algebra and trigonometry were taught prior to geometry.

It should be remembered that the ITED is primarily a developmental test and not a predictive device. The investigator suggests that further research needs to be done in attempting to predict success with such instruments as the Differential Apptitude Test. More research might be done to determine if there is a change in student and/or teacher attitudes during the second semester. The difference in reasoning which causes some students to do best in algebra while others are more successful in geometry might also be studied.

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APPENDICES

APPENDIX A

RAW DATA USED IN CORRELATIONS

9-1 tests	9-2 tests	Q scores	C scores
50	50	56	68
68	70	69	62
87	90	86	89
72	74	40	62
86	94	97	99
71	79	91	86
55	68	14	42
46	61	24	68
67	74	86	55
81	91	80	94
74	87	83	78
80	88	63	89
95	97	89	78
92	92	69	82
64	88	80	74
64	56	56	92
76	84	93	68
77	79	83	55
82	81	91	92
72	78	89	62
80	90	91	92
55	47	18	13
60	51	75	82
87	93	91	82
55	40	40	86
83	94	80	68
58	56	48	42
89	91	93	92
53	66	63	82
40	41	48	55
79	81	83	74
68	58	91	92
72	78	80	86
49	66	48	74
64	78	63	74
73	79	86	62
95	94	93	89
97	97	99	99
48	55	40	62
83	85	95	94

APPENDIX A: (CONTINUED)

9-1 tests	9-2 tests	Q scores	C scores
86	94	91	94
69	75	40	68
77	84	69	62
68	82	75	74
52	80	83	89
56	72	63	78
46	64	63	86
86	86	93	74
69	73	80	82
75	79	56	74
86	85	95	89
56	64	75	68
75	94	89	94
63	79	48	42
61	68	48	42
50	56	80	86
51	73	32	55
75	83	75	55
65	74	91	94
86	90	93	86
68	84	83	98
88	91	63	74
65	66	56	55
82	87	91	92
71	73	48	62
95	99	98	99
89	96	98	96
86	91	95	96
59	53	83	89
87	90	91	97
63	44	75	78
88	90	83	89
56	64	63	55
81	81	91	86
73	77	75	55
87	93	93	89
73	77	69	78
72	74	89	82
70	71	69	68
58	67	86	55
76	79	63	89
70	75	80	68
73	79	86	92
76	86	83	78

APPENDIX A: (CONTINUED)

9-1 tests	9-2 tests	Q scores	C scores
64	64	69	86
55	54	83	62
78	90	63	55
77	73	83	82
97	99	89	98
44	59	48	35
61	62	56	55
54	68	63	42
76	84	91	55
88	81	91	68
74	86	63	78
99	99	98	92
74	83	56	68
74	65	69	68
77	91	69	68
74	88	75	68
81	86	75	48

APPENDIX A: (CONTINUED)

9-1 tests	10-1 tests	10-2 tests	Q score	C score
50	36	42	56	68
68	76	71	69	62
87	92	88	86	89
86	92	83	97	99
71	86	86	91	86
81	93	78	80	94
74	77	82	83	78
80	88	76	63	89
95	95	98	89	78
92	85	83	69	82
64	80	84	80	74
76	71	63	93	68
77	78	66	83	55
82	75	81	91	92
80	90	89	91	92
60	76	79	75	82
83	86	82	80	68
89	93	94	93	92
79	79	70	83	74
68	60	56	91	92
49	54	49	48	74
73	82	77	86	62
95	89	90	93	89
97	98	95	99	99
83	80	81	95	94
86	95	88	91	94
69	86	85	40	68
68	78	75	75	74
52	84	87	83	89
86	90	87	93	74
69	79	82	80	82
75	74	93	56	74
86	89	87	95	89
56	65	72	75	68
75	95	93	89	94
63	55	59	48	42
61	67	62	48	42
75	90	86	75	55
65	74	61	81	94
86	74	71	93	86
68	83	76	83	98
65	49	47	56	55
82	91	87	91	92
95	97	96	98	99

APPENDIX A: (CONTINUED)

9-1 tests	10-1 tests	10-2 tests	Q score	C score
89	96	92	98	96
86	83	72	95	96
59	66	67	83	89
87	79	75	91	97
88	86	83	83	89
56	60	58	63	55
81	87	82	91	86
73	80	72	75	65
87	90	87	93	89
73	74	83	69	78
72	83	77	89	82
70	63	65	69	68
58	72	74	86	55
76	77	69	63	89
64	72	87	69	86
77	76	77	83	82
97	98	94	89	98
76	84	82	91	55
88	66	66	91	68
74	83	77	63	78
99	96	97	98	92
74	66	71	56	68
74	62	64	69	68
77	91	88	69	68
74	71	67	75	68
81	77	84	75	48

APPENDIX A: (CONTINUED)

9-1 tests	11-1 tests	11-2 tests	Q score	C score
87	80	77	86	89
86	84	95	97	99
81	65	66	80	94
95	96	98	89	78
92	73	75	69	82
64	75	81	80	74
80	78	80	91	92
60	58	46	75	82
83	83	94	80	68
89	89	89	93	92
79	56	64	83	74
73	67	53	86	62
95	89	93	93	89
97	89	101	99	99
83	78	74	95	94
52	59	42	83	89
86	77	63	93	74
75	67	68	56	74
86	66	58	95	89
63	67	54	48	42
75	63	50	75	55
86	72	59	93	86
82	79	83	91	92
95	93	101	98	99
89	93	102	98	96
86	76	92	95	96
88	76	82	83	89
81	76	81	91	86
87	91	98	93	89
73	62	52	69	78
72	62	67	89	82
77	59	38	83	82
97	97	105	89	98
88	58	37	91	68
74	75	80	63	78
99	92	88	98	92
77	76	77	69	68
81	70	64	75	48

APPENDIX A: (CONTINUED)

9-1 tests	12-1 tests	12-2 tests	Q scores	C scores
87	89	87	86	89
86	92	92	97	99
95	96	94	89	78
92	85	74	69	82
64	81	81	80	74
80	80	77	91	92
60	64	49	75	82
83	86	88	80	68
89	96	91	93	92
79	75	65	83	74
73	70	67	86	62
95	92	83	93	89
97	94	96	99	99
86	63	54	95	89
82	81	81	91	92
95	94	96	98	99
89	90	73	98	96
88	88	84	83	89
97	98	97	89	98
74	74	77	63	78
99	91	92	98	92
77	84	76	69	68

CORRELATION BETWEEN GRADES

X 9-1 tests	Y 12-1 tests	x $(X - \bar{X})$	y $(Y - Y)$
87	89	2.1	4.4
86	92	1.1	7.4
95	96	10.1	11.4
92	85	7.1	.4
64	81	-20.9	-3.6
80	80	-4.9	-4.6
60	64	-24.9	-20.6
83	86	-1.9	1.4
89	95	4.1	10.4
79	75	-5.9	-9.6
73	70	-11.9	-14.6
95	92	10.1	7.4
97	94	12.1	9.4
86	63	1.1	-21.6
82	81	-2.9	-3.6
95	94	10.1	9.4
89	90	4.1	5.4
88	88	3.1	3.4
97	98	12.1	13.4
74	74	-10.9	-10.6
99	91	14.1	6.4
77	84	-7.9	-.6
22 1867	22 1862		
$\bar{X} = 84.9$	$\bar{Y} = 84.6$		

Computation of the Standard Deviation of the X values:

$$\sigma x = \sqrt{\frac{\Sigma x^2}{N}} = \sqrt{\frac{2,348.62}{22}} = 10.33$$

Computation of the Standard Deviation of the Y values:

$$\sigma y = \sqrt{\frac{\Sigma y^2}{N}} = \sqrt{\frac{2,163.12}{22}} = 9.92$$

DIX B

RECEIVED IN 9-1 AND 12-1

x^2	y^2	xy
4.41	19.36	9.24
1.21	54.76	8.14
102.01	129.96	115.14
50.41	.16	2.84
436.81	12.96	75.24
24.01	21.96	22.54
620.01	424.36	512.94
3.61	1.96	-2.66
16.81	108.16	42.64
34.81	92.16	56.64
141.61	213.16	173.74
102.01	54.76	74.74
146.41	88.36	113.74
1.21	466.56	-23.76
8.41	12.96	10.44
102.01	88.36	94.94
16.81	29.16	22.14
9.61	11.56	10.54
146.41	179.56	162.14
118.81	112.36	115.54
198.81	40.96	90.24
62.41	.36	4.74
Σx^2 2,348.62	Σy^2 2,163.12	Σxy 1,961.88

Computation of the Coefficient of Correlation:

$$r = \frac{\Sigma xy}{N\sigma x\sigma y} = \frac{1,961.88}{22 \times 10.33 \times 9.92} = \frac{1,961.88}{2,254.42} = .87$$