SOME VALUES OF THE 1937 OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE MATHEMATICS PLACEMENT TEST IN PREDICTING SCHOLARSHIP.

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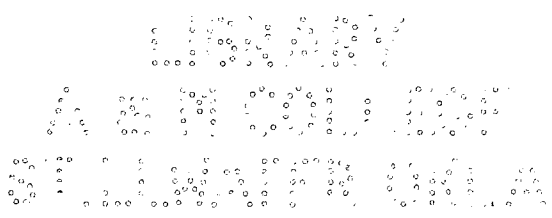

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M. M. D.

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PREFACE

The idea in making this study is to investigate the knowledge of arithmetic and algebra retained by the college freshman at the time of matriculation and particularly its influences on mathematics and chemistry grades in college. The problem had its inception in the different mathematics classes of which the writer was either a member or the instructor. The question that presents itself for solution at the present time is whether or not better knowledge of arithmetic and algebra at the time of matriculation will improve grades in college.

CHAPTER I

INTRODUCTION

Many students are completing high schools and entering engineering schools poorly prepared in the fundamentals of mathematics. These students usually have a difficult time in college learning the fundamentals of arithmetic that should have been mastered in the grades or in high school. This lack of articulation between mathematics in high schools and in colleges has an important influence upon their curricula. There is a need to improve scholarship in college and to reduce the large percentage of failures in mathematics.

Purpose of Study

The purpose of the study of the Oklahoma Agricultural and Mechanical College Mathematics Placement Test is threefold:

1. To evaluate the reliability of the arithmetic and algebra questions.
2. To determine how the tests may be used to predict success in college grades.
3. To determine the value of fundamental knowledge in arithmetic and algebra to chemistry and mathematics in college.

Procedure and Methods Used

The study compared the individual entrance scores on the arithmetic unit of the Oklahoma Agricultural and Mechanical College Mathematics Placement Test with grades in mathematics, chemistry, grade point average in college, and the percentile score on the Ohio State Psychological Test Number 17. The same procedure was used with the algebra unit.

The study included 434 students who took the test in September 1937. Most of these students were freshmen entering the school of Engineering; however, a few were entering each of the following schools: Agriculture, Home Economics, Commerce, Education, and Arts and Sciences.

Individual records of the 434 persons for the first semester 1937-38 were obtained from the registrar's office and the research department. It was found that there were students who had attended different sized high schools and in a number of states. Some of the states represented other than Oklahoma are: New Mexico, Arkansas, New York, Indiana, Texas, Illinois, Nevada, Missouri, Nebraska, Wyoming and Kentucky.

CHAPTER II

FINDINGS AND COMPARISON OF SCORES ON TESTS

The 1937 Oklahoma Agricultural and Mechanical College Mathematics Test is divided into four parts: namely, arithmetic, algebra, geometry, and composite mathematics. Parts one and two are used in this study. The exact questions are not for public study, but the following are similar to the ones in arithmetic:

1. Prime factors of 546 are _____. (A study of the papers indicated the students evidently did not know a prime factor or did not know that 91 can be factored.)

2. Write four hundred and five ten-thousandths as a decimal.

3. Addition of fractions, as: 2/3, 1/5, 5/8 .

4. Question four is to find the average of a group of numbers, such as: 3, 6, 7, 9, 0, 5 .

5. Find the product of 13.25 times zero.

6. Write the fourth power of four.

7. Divide decimals, as: .016256 by 1.29 .

8. Express in similar fraction as a decimal $\frac{8}{12\frac{1}{2}}$.

9. Simplify $\frac{7\frac{1}{2}}{3/4}$.

10. What is 1/6 % of 500?

11. Find the square root of 10,404.

12. Find $1\frac{1}{2}$ % of $18.40.

13. Divide 2/3 by .33 1/3 .

14. Change .0475 to common fraction and the lowest term.

15. Find the value of 6/7 x 1/3 - 1/14 .

16. What % of $12\frac{1}{2}$ is $2\frac{1}{2}$?

17. Find the product of 246 times .06 1/3.

18. Find the product of $4/7 \times 5/7 \times 3/4 \times 7/8$.

19. Find the value of $3\frac{1}{2} + 1/3 - (1/3)^2$.

20. Find the lowest common multiple of 8, 12, 16 .

Table I indicates the number answering correctly each question. For instance, only four out of 434 answered question one on factoring and 351 answered question four on finding the average of a group of numbers.

Table II shows that seven persons answered eighteen questions correctly; this was the highest number of correct answers; five did not answer any of the questions.

A comparison of the Tables I and II shows that even though each question was answered by some number of persons varying from four to 351, no individual answered correctly more than eighteen.

TABLE I

RESULTS OBTAINED FROM TWENTY QUESTIONS

IN THE ARITHMETIC TEST

Question Number	Cases Answered
1	4
2	271
3	322
4	351
5	260
6	216
7	241
8	135
9	146
10	150
11	160
12	174
13	114
14	107
15	203
16	93
17	169
18	115
19	123
20	27

TABLE II

RESULTS OF THE ARITHMETIC TEST SHOWING THE DISTRIBUTION OF ANSWERS FOR THE NUMBER OF QUESTIONS

SCORE	PERSONS ANSWERING
20	0
19	0
18	7
17	2
16	11
15	11
14	17
13	20
12	22
11	25
10	34
9	30
8	36
7	32
6	31
5	51
4	27
3	30
2	23
1	20
0	5
	434

The following questions are similar to the algebra questions in the tests studied:

1. Factor $x^2 - x - 2$.

2. Factor $a^3 + 27$.

3. Factor $4x^2 + 16xy + 16y^2 - 64$.

4. Expand $(x - 2)^3$.

5. Reduce $\frac{24y^2x^5}{16y^3x^5}$ to lowest terms .

Perform the operations indicated in the following:

6. $\frac{1}{x} - \frac{1}{xy}$.

7. $\frac{z}{2x} + \frac{2x}{y} - \frac{y}{x}$.

8. $(-x)(-x-y)(x-y)$.

9. $\sqrt{108} + \sqrt{75} - 2\sqrt{48}$.

10. $\frac{x+3}{x-3} - \frac{x-3}{x+2}$.

11. Simplify: $\dfrac{\frac{x+1}{x}}{1 - \frac{1}{x^2}}$

12. Simplify: $\frac{\sqrt{5}+1}{\sqrt{5}-1}$.

Solve for x in each of the following:

13. $\frac{1}{x} = 3$.

14. $m + rx = s + tx$.

15. $\frac{b^2}{x^2} = \frac{16}{25}$.

16. $x^2 - x = 2$.

17. $\frac{x}{3} - 5 = \frac{x}{4} + 3$.

18. Solve for x and y :

$4x - 3y = 15$

$3x - 4y = 13$.

19. Solve for x :

$L = b + (n - 1)\, x$.

20. Solve for L :

$$P = \frac{\pi\sqrt{L}}{3}$$

Table III shows the number of persons solving each problem correctly in the algebra test. Six solved question three and 226 question one.

TABLE III

NUMBER OF PERSONS SOLVING EACH PROBLEM ON THE ALGEBRA TEST

Question Number	Cases Answered
1	226
2	14
3	6
4	89
5	159
6	50
7	40
8	91
9	34
10	25
11	29
12	11
13	159
14	54
15	38
16	56
17	53
18	43
19	21
20	7

Table IV presents the distribution of the 434 persons and the total number of problems solved per person. There was one who answered sixteen, one seventeen, and one eighteen, while 122 failed to solve any correctly.

A comparison of Tables III and IV shows that although each question in algebra was answered by a number of people, varying from six to 226, no individual correctly answered more than eighteen.

From Table IV it appears that only twenty of the 434 individuals taking the test made scores greater than ten.

TABLE IV

RESULTS OF THE ALGEBRA TEST SHOWING

THE DISTRIBUTION OF ANSWERS FOR THE NUMBER OF QUESTIONS

Score	Persons Answering
20	0
19	0
18	1
17	1
16	1
15	3
14	4
13	3
12	4
11	3
10	9
9	3
8	7
7	14
6	17
5	19
4	24
3	60
2	51
1	88
0	122
	434

The coefficient of reliability was determined by the odd-even method, and corrected by the Spearman Brown formula. This showed the coefficient of reliability of arithmetic to be .820; of algebra .873 .

Table V presents the entrance score in arithmetic, and A, B, D, E, I, and F grades in mathematics studied in college the first semester 1937-38. Grades of C are not considered in any part of this study.

Table V (a) shows that ten persons made a score less than seven and made A or B grades in mathematics 030 (algebra), while eight persons made seven or more and made either D or F grades. Mathematics 030 is a course in remedial algebra offered for those weak in the fundamentals.

Table V (b) shows that seven persons scored three or less and made A or B grades in mathematics 050 (algebra); seven persons scored more than three but made D or F grades. The content of Mathematics 050 is the same as mathematics 030 but necessitates five hours per week instead of three.

Table V (c) shows that ten persons who scored less than twelve made A or B grades in college algebra (mathematics 144), although fifteen persons scored twelve or above but made D, E, I and F grades.

Table V (d) shows that four persons scored less than eight, yet made A or B grades in solid geometry (mathematics 153), while three persons scored more than eight and made D or F grades.

Table V (e) shows that thirteen persons scored less than twelve, yet made A and B grades in mathematics 112 (plane trigonometry), and sixteen persons scored twelve or more but made D, I, and F grades.

A comparison of the five divisions of Table V shows that the arithmetic scores for persons studying trigonometry and geometry are higher than for persons studying other mathematics courses. Trigonometry is more advanced than other mathematics courses involved in this study.

TABLE V

DISTRIBUTION TABLE OF THE ARITHMETIC SCORES

AND MATHEMATICS GRADES IN COLLEGE

ARITH-METIC SCORE	ALGEBRA MATH.030						ALGEBRA MATH.050						ALGEBRA MATH. 144						SOLID GEOM. MATH. 153						TRIG. MATH. 112					
	A	B	D	E	I	F	A	B	D	E	I	F	A	B	D	E	I	F	A	B	D	E	I	F	A	B	D	E	I	F
20																														
19																														
18													1	1					1						1					
17													1												1					
16													3	2		1	1	1							2	2	1		1	1
15													2		3					1						3	1			1
14	1												2	7	1					1	1				4	1	1			1
13	1	1											1	5	1				1	1					2	3	1			2
12		2											2	3	3			4		1					3	1	2			4
11	3	1					1						1	1	3	1		2		1	1					3	2		1	4
10	5	2	1			2	2							2	2			2	3	3				1		4				2
9	2	1				2								5	3			2		1	1			1	1	2	1			3
8	3	3	1				1					1	1		1	1				2						1	4	1		
7	3	3	2												2			3	2	1	1			2	1	1				1
6	1	3	3			2	2	2										1			5									
5		5	2		1	3	1	6	2			2								1	1			5			1			
4						1	1	2	1			1										1		4						
3			1	1		2	2	2	3			4						1			1			4						
2		1	1		1	1						2												2						
1						1	1	2	1			4												2						
0									1																					
	(a)						(b)						(c)						(d)						(e)					

Table VI is a distribution of the arithmetic scores showing good and poor grades in any algebra course and in geometry or trigonometry. Good grades are considered A and B, while poor grades are D, E, I, and F, in all comparisons.

TABLE VI

DISTRIBUTION TABLE OF THE ARITHMETIC SCORES WITH

ALGEBRA, TRIGONOMETRY AND GEOMETRY GRADES

ARITHMETIC SCORE	ALGEBRA 030,050,144						GEOM.AND TRIG.					
	A	B	D	E	I	F	A	B	D	E	I	F
20												
19												
18	1	1					2					
17	1						1					
16	3	2		1	1	1	2	2	1		1	1
15	2		3					4	1			1
14	3	7	1				4	2	2			1
13	2	6	1				3	4	1			2
12	2	5	3			4	3	2	2			4
11	5	2	3	1		2		4	3		1	4
10	7	4	3			4	3	7				3
9	2	6	3			4	1	3	2			4
8	5	3	2	1		1		3	4	1		
7	3	3	4			3	3	2	1			3
6	3	5	3			3			5			
5	1	11	4		1	5		1	2			5
4	1	2	1			2				1		4
3	2	2	4	1		7			1			4
2		1	1		1	3						2
1	1	2	1			5						2
0			1									
	(a)						(b)					

Tables VII and VIII present the arithmetic score and the grades in algebra corresponding to the score.

Table VII shows that three persons scored one on arithmetic, yet made A or B grade in college algebra.

Table VIII shows that three persons scored sixteen in arithmetic, yet made poor grades in college algebra.

From Tables VII and VIII, it is found that in spite of extreme scores, the general tendency is that those with higher scores on the arithmetic test made better grades in college algebra.

TABLE VII

DISTRIBUTION OF ARITHMETIC SCORES AND GRADES IN ALGEBRA

Entrance Score in Arithmetic	A and B Grades in Algebra
20	0
19	0
18	2
17	1
16	5
15	2
14	10
13	8
12	7
11	7
10	11
9	8
8	8
7	6
6	8
5	12
4	3
3	4
2	1
1	3
0	0
	106

Mean 9.368

Standard deviation 4.08

TABLE VIII

Entrance Score in Arithmetic	D,E,I,F Grades in Algebra
20	0
19	0
18	0
17	0
16	3
15	3
14	1
13	1
12	7
11	6
10	7
9	7
8	4
7	7
6	6
5	10
4	3
3	12
2	5
1	6
0	1
	89

Mean 6.877

Standard deviation 4.159

Tables IX and X show the entrance arithmetic score and the grades in geometry and trigonometry corresponding to the score.

Table IX shows that no one scored less than seven on arithmetic and made A or B grade in geometry or trigonometry.

Table X shows that three persons scored sixteen on arithmetic, yet made poor grades in geometry and trigonometry.

TABLE IX

ARITHMETIC SCORES AND GRADES IN GEOMETRY AND TRIGONOMETRY

Entrance Score in Arithmetic	A and B Grades in Geometry & Trigonometry
20	0
19	0
18	2
17	1
16	4
15	4
14	6
13	7
12	5
11	4
10	10
9	4
8	3
7	5
6	0
5	1
4	0
3	0
2	0
1	0
0	0
	56

Mean 12.285

Standard deviation 3.063

TABLE X

Entrance Score in Arithmetic	D,E,I,F,Grades in Geometry & Trigonometry
20	0
19	0
18	0
17	0
16	3
15	2
14	3
13	3
12	6
11	8
10	3
9	6
8	5
7	4
6	5
5	7
4	5
3	5
2	2
1	2
0	0
	69

Mean 9.608

Standard deviation 4.229

The sigma of the mean of the arithmetic scores for persons with good grades in algebra[1] was found by dividing the sigma of the distribution by the square root of the number of cases. The sigma of the mean of the arithmetic scores for persons with poor grades in algebra[2] was found by dividing the sigma of the distribution by the square root of the number of these cases. The sigma of the mean of the arithmetic scores for persons having good grades in trigonometry and geometry[3] was found in a similar manner and the same method was used to obtain the sigma of the mean of the arithmetic scores for persons with poor grades in trigonometry and geometry[4]. The students who made good grades in algebra had a mean arithmetic score of 9.368. Those who made poor grades in algebra had a mean arithmetic score of 6.877. This is a difference of 2.491. The sigma of this difference[5] is .591 and the critical ratio[6] is 4.21, which signifies that there is less than one chance in ten thousand[7] that those who made poor grades in algebra would ever have a mean on the arithmetic test higher than the mean for those who make good grades in algebra.

The students who made good grades in geometry and trigonometry had a mean arithmetic score of 12.285. Those who made poor grades in geometry and

---

1. $\frac{4.08}{\sqrt{106}} = .396$ sigma of mean in good algebra grades with arithmetic.
2. $\frac{4.1593}{\sqrt{89}} = .439$ sigma of mean in poor algebra with arithmetic.
3. $\frac{3.063}{\sqrt{56}} = .411$ sigma of mean in good geometry and trigonometry grades.
4. $\frac{4.229}{\sqrt{69}} = .509$ sigma of mean in poor geometry and trigonometry grades.
5. Sigma of difference of good and poor grades in al. $\sqrt{(.396)^2 + (.439)^2} = .591$.
6. $9.368 - 6.877 = 2.491$ $\frac{2.491}{.591} = 4.21$ critical ratio in algebra.
7. Garrett, H. E., Statistics in Psychology and Education. p. 132.

trigonometry had a mean arithmetic score of 9.608. This is a difference of 2.677. The sigma of this difference[8] is .654, and the critical ratio[9] is 4.093.

Since it is customary to take a critical ratio of three as indicative of complete reliability, the chances in geometry and trigonometry are similar to ones previously mentioned.

Tables XI and XII reveal the scores and the ratios explained in the preceding statement.

---

8. Sigma of difference of good and poor grades in geometry and trigonometry $\sqrt{(.411)^2 + (.509)^2} = .654$.

9. $12.285 - 9.608 = 2.677$. $\frac{2.677}{.654} = 4.093$ critical ratio in geom. & trig.

TABLE XI

ARITHMETIC TEST SCORES

COMPARED TO GRADES IN ALGEBRA

	Good Students (A, B)		Poor Students (D, E, I, F)
N	106		89
Mean	9.368		6.877
Standard deviation	4.08		4.159
Sigma of the mean	.396		.439
Difference of mean		2.491	
Sigma of the difference		.591	
Critical ratio		4.21	

TABLE XII

ARITHMETIC TEST SCORES COMPARED

WITH GRADES IN GEOMETRY AND TRIGONOMETRY

	Good Students (A, B)		Poor Students (D, E, I, F)
N	56		69
Mean	12.285		9.608
Standard deviation	3.063		4.229
Sigma of mean	.411		.509
Difference of mean		2.677	
Sigma of the difference		.654	
Critical ratio		4.093	

Table XIII (a) shows that thirteen persons scored less than seven, but made A or B grades in Chemistry 114, while twenty-two persons scored more than seven yet made D, E, I, AND F grades.

Table XIII (b) shows that fifteen persons scored less than thirteen, but made A or B grades in Chemistry 154, while none scored more than thirteen and failed.

Table XIII reveals that very few who made high scores on the arithmetic test made poor grades in Chemistry.

TABLE XIII

DISTRIBUTION TABLE OF ARITHMETIC SCORES

AND COLLEGE CHEMISTRY GRADES

ARITHMETIC SCORE	CHEMISTRY 114						CHEMISTRY 154					
	A,	B	D	E	I	F	A	B	D	E	I	F
20												
19												
18	1	2					1					
17	1											
16	1	2				1	1					
15	2		1									
14	1	1		1			2	3				
13	2	4					3	2				
12	1	2	1			1	1				1	
11	1	4					1	2	1			
10	1	10	4	1	1		1					
9	1	7	1			4	2					1
8	2	9	3			3	1	1			1	
7	2	2	5		1	3	1	1				
6		1	5	1	1	3		1			1	1
5		6	8			11	1	1			1	
4		2	5			9						
3			2			8					4	
2		2	4			5		1				
1		1	1			5						
0		1				2						
	(a)						(b)					

Table XIV shows that one person scored zero on arithmetic, yet made A or B in college chemistry.

Table XV shows that one person scored as high as sixteen, but made a poor grade in college chemistry.

Tables XIV and XV were used to find the means of the good and the poor students. The mean and the standard deviation[1] of the arithmetic scores were found for each group. These results were used to obtain the sigmas of the means[2], the sigma of the difference[3], and the critical ratio[4], all of which are found in Table XVI.

---

1. Standard deviation - good grades $\sqrt{\frac{1527}{99} - (.07)^2} = 3.926$

   Standard deviation - poor grades $\sqrt{\frac{1139}{112} - (.5625)^2} = 3.139$

2. $\frac{3.926}{\sqrt{99}}$ .395 sigma of mean of good grades.

   $\frac{3.139}{\sqrt{112}}$ .296 sigma of mean of poor grades.

3. $\sqrt{(.395)^2 + (.296)^2} = \sqrt{.243641} = .494$ sigma of difference

4. $9.93 - 5.562 = 4.368 \quad \frac{4.368}{.494} = 8.842$ critical ratio

TABLE XIV

TABLE XV

ARITHMETIC SCORES AND GRADES IN COLLEGE CHEMISTRY

Score in Arithmetic	A and B Grades in Chemistry	Score in Arithmetic	D,E,I,F,Grades in Chemistry
	N		N
20	0	20	0
19	0	19	0
18	4	18	0
17	1	17	0
16	4	16	1
15	2	15	1
14	7	14	1
13	11	13	0
12	4	12	3
11	8	11	1
10	12	10	6
9	10	9	6
8	13	8	7
7	6	7	9
6	2	6	12
5	8	5	20
4	2	4	14
3	0	3	14
2	3	2	9
1	1	1	6
0	1	0	2
	99		112
Mean 9.930		Mean 5.563	
Standard deviation 3.926		Standard deviation 3.139	

TABLE XVI

ARITHMETIC TEST SCORES

COMPARED TO COLLEGE CHEMISTRY

	Good Students (A, B)		Poor Students (D, E, I, F)
N	99		112
Mean	9.930		5.563
Standard deviation	3.926		3.139
Sigma of mean	.395		.296
Difference of mean		4.372	
Sigma of the difference		.494	
Critical ratio		8.842	

Table XVII (a) and (b) divisions show that students may make zero scores on the entrance algebra test and even make A and B grades in mathematics 030 (intermediate algebra) and mathematics 050 (intermediate algebra). One person scored eight, which was the highest score made. All the rest made below six, yet forty persons made A and B grades while twenty-eight persons made D, E, I, and F grades.

Table XVII (c) shows that twenty-one persons scored less than eight and made A or B grade in mathematics 144 (college algebra), while three scored more than eight and made D grades.

Table XVII (d) shows that eleven persons scored less than three and made A or B grades in mathematics 153 (solid geometry), while three scored three or more and made F grades.

Table XVII (e) shows that seventeen persons scored less than eight and made A or B grades in trigonometry, while there were none who scored more than eight and made poor grades.

From a comparison of all divisions of Table XVII it is found that all who scored more than ten on the entrance algebra test made good grades in mathematics.

TABLE XVII

DISTRIBUTION TABLE OF ENTRANCE ALGEBRA SCORES AND MATHEMATICS

ALGEBRA SCORE	ALGEBRA MATH.030							ALGEBRA MATH. 050							ALGEBRA MATH. 144							SOLID GEOM. MATH.153							TRIG. MATH.112						
	A	B	D	E	I	F		A	B	D	E	I	F		A	B	D	E	I	F		A	B	D	E	I	F		A	B	D	E	I	F	
20																																			
19																																			
18																																			
17															1															1						
16																																			
15															2														1	2						
14															2	1													2							
13															1															1						
12																2														1						
11															2														2	1						
10															2		3					1								3						
9															1							1							1	1						
8	1														2	3			1				1						2	1			1			
7																5	1			1									2	2	1	1		1		
6															1	1	3	1		2									1		2		1	2		
5	1	2														4	2						1				1		3		2			2		
4		1				1										3	2			3		2								4				1		
3	6	5	1	1		2			1	1						6	5			4		1	2				2		1	4	4			7		
2	2	6	2			2		1		1			1				1			4			5	1	1	5				1				3		
1	7	4	3			5		5	5	1			2			1	2	2		2		1	3	6			2			1				3		
0	2	4	5		2	4		5	8	5			11									1	1	4			11			1						
	(a)							(b)							(c)							(d)							(e)							

Tables X VIII and XIX show the entrance algebra scores compared with grades in college algebra and with trigonometry and geometry. The tables show that one person scored seventeen on entrance algebra and made A in college algebra, while one person scored seventeen on entrance algebra and made B in geometry or trigonometry.

TABLE XVIII

TABLE XIV

COMBINED SCORES OF ENTRANCE ALGEBRA AND COLLEGE MATHEMATICS

Score in Entrance Algebra	Grades in College Algebra						Score in Entrance Algebra	Grades in Trig. and Geom.					
	A	B	D	E	I	F		A	B	D	E	I	F
20							20						
19							19						
18							18						
17	1						17	1					
16							16						
15	2						15	1	2				
14	2	1					14	2					
13	1						13		1				
12		2					12		1				
11	2						11	2	1				
10	2		3				10	1	3				
9	1						9	2	1				
8	3	3			1		8	2	2			1	
7		5	1			1	7	2	2	1	1		1
6	1	1	3	1		2	6	1		2		1	2
5	1	6	2				5	3	1	2			3
4		4	2			4	4	2	4				1
3	6	12	7	1		6	3	2	6	4			9
2	3	6	4			7	2		5	2	1		8
1	12	10	6	2		9	1	1	3	7			5
0	7	12	10		2	15	0	1	1	5			11

Table XX shows the entrance algebra score and the number making A or B grades in college algebra. For instance, twenty-two persons scored one, yet made A or B grades in college algebra.

Table XXI shows the entrance algebra scores and the number making D, E, I, AND F grades in college algebra. It is found none scored above ten and made a poor grade.

From a comparison of Tables XX and XXI it appears that all who scored high on the entrance algebra test made good grades in algebra.

TABLE XX

ENTRANCE ALGEBRA SCORES AND GRADES IN ALGEBRA

Entrance Score in Algebra	A & B Grades College Algebra N
20	0
19	0
18	0
17	1
16	0
15	2
14	3
13	1
12	2
11	2
10	2
9	1
8	6
7	5
6	2
5	7
4	4
3	18
2	9
1	22
0	19
	106

Mean 3.934

Standard deviation 4.151

TABLE XXI

Entrance Score in Algebra	D,E,I,F Grades Algebra N
20	0
19	0
18	0
17	0
16	0
15	0
14	0
13	0
12	0
11	0
10	3
9	0
8	1
7	2
6	6
5	2
4	6
3	14
2	11
1	15
0	27
	87

Mean 2.310

Standard deviation 2.501

Table XXII shows the entrance algebra scores and the A or B grades in geometry or trigonometry. This table shows that two persons scored zero on entrance algebra yet made A or B grades in geometry or trigonometry.

Table XXIII shows the entrance algebra scores and the poor grades in geometry and trigonometry. This Table shows also that no person scored more than eight and made a poor grade in either geometry or trigonometry.

A comparison of Tables XII and XXIII reveals that all who made high scores on the entrance algebra test made good grades in trigonometry and geometry.

TABLE XXII

ENTRANCE ALGEBRA SCORES AND GRADES IN TRIGONOMETRY AND GEOMETRY

Entrance Score in Algebra	A and B Grades Trigonometry Geometry
20	0
19	0
18	0
17	1
16	0
15	3
14	2
13	1
12	1
11	3
10	4
9	3
8	4
7	4
6	1
5	4
4	6
3	8
2	5
1	4
0	2
	56

Mean 6.482

Standard deviation 4.436

TABLE XXIII

Entrance Score in Algebra	D,E,I,F Grades Trigonometry Geometry
20	0
19	0
18	0
17	0
16	0
15	0
14	0
13	0
12	0
11	0
10	0
9	0
8	1
7	3
6	5
5	5
4	1
3	13
2	11
1	12
0	16
	67

Mean 2.403

Standard deviation 2.179

The sigma of the mean of entrace algebra scores for persons having good[1] algebra grades was found by dividing the sigma of the distribution by the square root of the number of cases. The sigma of the mean of entrance algebra scores for persons having poor[2] algebra grades was found by dividing the sigma of the distribution by the square root of the number of cases.

The same procedure was used to find the sigma of the mean of entrance algebra scores for persons having good trigonometry and geometry[3] grades, and also in a similar manner was found the sigma of the mean of entrance algebra scores for persons having poor trigonometry and geometry[4] grades.

The students who made good grades in algebra had a mean algebra score of 3.934 . Those who made poor grades in algebra had a mean algebra score of 2.501 . This is a difference of 1.624. This sigma of the difference[5] is .483 .

The students who made good grades in geometry and trigonometry had a mean algebra score of 6.482 . Those who made poor grades in geometry and trigonometry had a mean algebra score of 2.403. This is a difference of 4.079 . This sigma of the difference[6] is .650 .

---

1. $\frac{4.151}{\sqrt{106}} = .403$ sigma of mean in good algebra grades with entrance alg.
2. $\frac{2.501}{\sqrt{87}} = .270$ sigma of mean in poor algebra grades with entrance alg.
3. $\frac{4.437}{\sqrt{56}} = .593$ sigma of mean in good trigonometry and geometry grades with entrance alg.
4. $\frac{2.179}{\sqrt{67}} = .266$ sigma of mean in poor trigonometry and geometry grades with entrance alg.
5. $\sqrt{(.40)^2 + (.27)^2} = .483$ sigma of difference of the good and poor grades in algebra with entrance alg.
6. $\sqrt{(.592)^2 + (.266)^2} = .650$ sigma of differnce of the good and poor grades in trigonometry and geometry with entrance alg.

The difference of the mean of the good grades and the mean of the poor grades in algebra is divided by the sigma of the difference to find the critical ratio.[1] Table XXIV shows that this critical ratio is 3.362; which means that there are better than 9999* out of ten thousand chances that those who make good grades in algebra will always have a higher average on the entrance test than those who make poor grades.

The same method is used to obtain the critical ratio of entrance algebra scores with geometry and trigonometry[2]. Table XXV shows that the critical ratio is 6.275, which indicates small chance that the result obtained will ever be reversed.

---

1. $3.934 - 2.310 = 1.624$ $\frac{1.624}{.483} = 3.362$ Critical ratio of entrance algebra and college algebra

2. $6.482 - 2.403 = 4.079$ $\frac{4.079}{.65} = 6.275$ Critical ratio of entrance Algebra and Trigonometry and Geometry.

* Garrett, H. E., Statistics in Psychology and Education. p.132

TABLE XXIV

ALGEBRA TEST SCORES COMPARED

TO GRADES IN ALGEBRA

	Good Students (A & B)		Poor Students (D, E, I, F)
N	106		87
Mean	3.934		2.310
Standard deviation	4.151		2.501
Sigma of mean	.403		.270
Difference of mean		1.624	
Sigma of the difference		.483	
Critical ratio		3.362	

TABLE XXV

ALGEBRA TEST SCORES COMPARED TO

GRADES IN GEOMETRY AND TRIGONOMETRY

	Good Students (A & B)		Poor Students (D, E, I, F)
N	56		67
Mean	6.482		2.403
Standard deviation	4.436		2.179
Sigma of mean	.593		.266
Difference of mean		4.079	
Sigma of the difference		.650	
Critical ratio		6.275	

Table XXVI (a) shows that forty-three persons scored less than four on the entrance algebra questions and made A or B grades in Chemistry 114; while only four persons scored more than four and made D or F grades in the same chemistry course.

Table XXVI (b) shows that eleven persons scored less than four and made A or B grades in Chemistry 154, while no one scored more than three and made a poor grade.

Although the scores mentioned above are found, Table XXVI shows that none made poor grades in chemistry who had scored more than eight in entrance algebra.

TABLE XXVI

ENTRANCE ALGEBRA SCORES COMPARED WITH GRADES

IN COLLEGE CHEMISTRY

ALGEBRA SCORE	CHEM. 114						CHEM. 154					
	A	B	D	E	I	F	A	B	D	E	I	F
20												
19												
18												
17		1										
16												
15							1					
14							1	1				
13		1					1					
12							1					
11	1	1										
10	2											
9							1					
8		1				1	2					
7		4				1		2				
6	3	2	1					2				
5		4	1				1	1				
4	2	7	4				1					
3	2	10	4	1	1	6	1	1	1	2		
2	1	4	8	1	1	3	1			2	1	
1	4	13	11	1		16	2	2		3		
0	1	8	11		1	28	1	3		1	1	
	(a)						(b)					

Tables XXVII and XXVIII show the frequency of the good and of the poor grades in college chemistry compared with the score on the entrance algebra test.

Table XXVII shows that thirteen persons scored zero on the entrance algebra, yet made A or B grade in college chemistry.

Table XXVIII shows that no person who scored more than eight on entrance algebra made a poor grade in college chemistry.

TABLE XXVII

TABLE XXVIII

ENTRANCE ALGEBRA SCORES AND GRADES IN COLLEGE CHEMISTRY.

Entrance Score In Algebra	A, B Grades in Chemistry	Entrance Score in Algebra	D,E,I,F Grades in Chemistry
20	0	20	0
19	0	19	0
18	0	18	0
17	1	17	0
16	0	16	0
15	1	15	0
14	2	14	0
13	2	13	0
12	1	12	0
11	2	11	0
10	2	10	0
9	1	9	0
8	3	8	1
7	6	7	1
6	7	6	1
5	6	5	1
4	10	4	4
3	14	3	15
2	6	2	16
1	21	1	31
0	13	0	42
	98		112

Mean 4.010

Standard deviation 3.929

Mean 1.339

Standard deviation 1.544

The sigma of the mean of entrance algebra scores for persons having good grades in chemistry[1] was found by the method previously used. The sigma of the mean of entrance algebra scores for persons having poor grades in chemistry[2] also was found by the same method.

Table XXIX presents the sigma of the difference between the two groups[3].

Table XXIX shows that the critical ratio[4] is 6.424, indicating that there are more than 9999* out of ten thousand chances that the students who make the better grades, will have the higher average on the entrance test.

---

1. $\frac{3.929}{\sqrt{98}} = .3969$ or .397 sigma of the mean for good chemistry grades

2. $\frac{1.544}{\sqrt{112}} = .145$ sigma of the mean for poor chemistry grades.

3. Sigma of the difference $\sqrt{(.397)^2 + (.145)^2} = .422$

4. $2.671 \div .422 = 6.424$ $\quad 4.010 - 1.339 = 2.671$

* Garrett, H.E., Statistics in Psychology and Education. p. 132

TABLE XXIX

ALGEBRA TEST SCORES COMPARED

TO GRADES IN COLLEGE CHEMISTRY

	Good Students (A, B)		Poor Students (D, E, I, F)
N	98		112
Mean	4.010		1.399
Standard deviation	3.929		1.544
Sigma of the mean	.397		.135
Difference of the mean		2.671	
Sigma of the difference		.422	
Critical ratio		6.424	

Table XXX shows the intercorrelations of the arithmetic entrance test scores (0), the grade point average (1), the Ohio State Psychological test scores (2), and the entrance test scores in algegra (3).

TABLE XXX

INTERCORRELATIONS OF

(0) ARITHMETIC; (1) GRADE POINT; (2) OHIO STATE PSYCHOLOGICAL TEST NO. 17; (3) ENTRANCE ALGEBRA SCORE

		ARITHMETIC (0)	GRADE POINTS (1)	INTELLIGENCE (2)	ALGEBRA (3)
Arithmetic	(0)	1.00	.42	.42	.65
Grade Points	(1)	.42	1.00	.40	.38
Intelligence	(2)	.42	.40	1.00	.46
Algebra	(3)	.65	.38	.46	1.00

Table XXXI shows that the partial correlation between the arithmetic and algebra scores would be .564, with grade point average held constant.

If all persons had the same intelligence, the higher partial correlation would be .566, between arithmetic and algebra, while the partial correlation would be .303, between arithmetic and grade point average.

TABLE XXXI

PARTIAL CORRELATIONS[1] OF

(0) ARITHMETIC (1) GRADE POINT AVERAGE

(2) OHIO STATE PSYCHOLOGICAL TEST (3) ENTRANCE ALGEBRA

$r_{01.2} = .303$	$r_{02.1} = .303$	$r_{12.0} = .271$	$r_{02.3} = .164$
$r_{03.5} = .566$	$r_{03.1} = .584$	$r_{13.0} = .155$	$r_{01.3} = .246$
$r_{13.2} = .240$	$r_{23.1} = .366$	$r_{23.0} = .396$	$r_{12.3} = .274$

---

1. Formula used: $r_{01.2} = \dfrac{r_{01} - r_{02}\, r_{12}}{\sqrt{1-(r_{02})^2}\,\sqrt{1-(r_{12})^2}}$

Table XXXII shows that the correlation between arithmetic scores and grade point average would be .231, if every one had the same intelligence and knowledge in entrance algebra. This table shows that the correlation between grade points and intelligence would also be .231, if every one had the same knowledge in arithmetic and entrance algebra. The correlation between arithmetic scores and intelligence scores would be .113, if every one had the same grade point average and knowledge in entrance algebra.

TABLE XXXII

PARTIAL CORRELATIONS[1] OF

(0) ARITHMETIC (1) GRADE POINT AVERAGE

(2) OHIO STATE PSYCHOLOGICAL TEST (3) ENTRANCE ALGEBRA

$r_{01.23} = .231$ $r_{02.13} = .115$ $r_{12.03} = .231$

---

1. Formula used: $r_{01.23} = \dfrac{r_{01.2} - r_{03.2}\ r_{13.2}}{\sqrt{1 - (r_{03.1})^2}\sqrt{1 - (r_{13.2})^2}}$

SUMMARY AND CONCLUSIONS

This study is based on parts one and two of the Mathematics Placement Test, given to 434 students entering the Oklahoma Agricultural and Mechanical College in September 1937.

The arithmetic questions have a reliability of .820, while the algebra questions have a reliability of .876. The prediction can be made that students who understand fully the fundamentals of arithmetic and algebra make better grades in college. Persons who score high in the arithmetic and entrance algebra tests tend to make higher grades in chemistry and mathematics, particularly in the more advanced courses in mathematics.

The correlation between the entrance test in arithmetic and first semester scholarship is .42; even with intelligence partialed out the correlation is .303. The correlation between entrance test in algebra and first semester scholarship is .38; with intelligence partialed out it is .240. These findings show that there is a relationship between knowledge of high school mathematics and success in college, even on the assumption that every one had the same intelligence. Arithmetic is in this respect more important than algebra.

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