THE RELATIONSHIP OF CERTAIN FACTORS TO SEMESTER
MARKS IN FIRST YEAR ALGEBRA

by

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Sr. M. A. H.
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THE RELATIONSHIP OF CERTAIN FACTORS TO SEMESTER MARKS IN FIRST YEAR ALGEBRA

I. INTRODUCTION

Considerable progress has been made in the educational world during the last decade or two toward adjusting the curriculum and methods of instruction to the needs and abilities of the child. Present-day educators have evolved their theories from the democratic principle that the school is for the child whose interests and capacities are of paramount importance. The goal, then, of modern education is a complete understanding and adjustment of all school pupils.

A cursory examination of current literature, however, reveals the existence of a wide discrepancy between the goal sought and the goal attained, if school marks measure this attainment. Failures, involving very definite losses, are all too common occurrences, especially in the first year of high school life. Many pupils are denied the wholesome stimulus of success—an essential to normal development and mental health. Ninth grade pupils, in general, are unable to convert failure into success by regarding the performance of a task to the best of their ability as more significant than the teacher's mark for the work. Hence they are malnourished educationally, socially, and spiritually.

Impressed by the seriousness of these losses suffered by pupils in our high schools, the writer has undertaken
the present study of the relationship between certain facts commonly recorded about ninth grade boys and girls and semester marks in first year algebra, marks being deemed the criterion of success or failure. As a mathematics major, she is not proud of the high rank that algebra holds in school fatalities. It stands at, or near, the top, as indicated by studies to be cited later in the thesis.

In behalf of its clientele the mathematics department cannot afford merely to regret the appalling situation and continue to accept the high percentage of failure of the past years as a necessary and rightful precedent. Counts¹ in his study of curriculum making in public high schools found that a majority of mathematics teachers were willing to see a reduction in the number of pupils studying their subject. In the hope that mathematics may not become a closed book to those pupils capable of mastering it, the writer is seeking for some small contribution to the failure problem through a careful study of facts commonly recorded about pupils.

II. THE PURPOSE AND PROBLEMS OF THIS STUDY

A. The Purpose

The purpose of this study is to determine which of the facts commonly recorded about pupils can be used most effectively to guide pupils, especially those whose probabilities of success in algebra are very slight. In other words, can some failures be averted if the school interprets certain data which it can secure before the pupil's entrance or early in the semester before failure occurs? The determination of factors contributing to success is to be made through an investigation of the relationship between certain commonly recorded facts and semester marks in first year algebra for all pupils enrolled in first year algebra in Jefferson, West Lafayette, and St. Francis High Schools of Lafayette, Indiana, during the semester from September, 1931, to February, 1932.

B. The Problems

The proposed investigation of the relationship between semester marks in first year algebra and certain recorded facts resolves itself into two major problems:

1. To determine the relationship between semester marks in first year algebra and each of the following factors:
   a. Mental age,
   b. Intelligence quotient,
   c. Chronological age,
d. Eighth grade achievement in arithmetic,
e. Eighth grade average scholarship,
f. Occupation of the parents,
g. Per cent absence.

2. To compare the coefficient of mean square contingency with:
   a. The Pearson product-moment coefficient of correlation computed from raw scores,
   b. The Pearson product-moment coefficient of correlation computed from frequency tables,
   c. The correlation ratio.
III. THE DATA AND THE METHOD OF TREATING THE DATA

A. The Data.

1. Sources of the data. The data for this study were secured from the school records on file in the principals' offices of the three commissioned high schools and the elementary schools of Lafayette and from the elementary schools of the various communities from which pupils enter these high schools. Records on file in the county and city superintendents' offices were also used.

a. Jefferson High School. This is a public high school with an enrollment of approximately 1270. It draws its students from the elementary schools of Lafayette, both public and parochial. A few of its students enter from some of the rural elementary schools of Tippecanoe County, and another small group whose parents have recently moved to Lafayette come from elementary and junior high schools of other communities. The courses of study offered are the general, college preparatory, vocational home economics, vocational industrial arts, commercial course (accounting), commercial course (secretarial), industrial arts course, and household arts course.

b. West Lafayette High School. This public high school has an enrollment of approximately 290 students, drawn principally from the public elementary school of West Lafayette. The rural elementary schools of the county furnish
a small number of students while elementary and junior high schools of other communities furnish a considerable quota of students. Many of those enrolled in West Lafayette High School are sons and daughters of Purdue University teachers or of fathers and mothers who have moved to West Lafayette that their children may attend Purdue. The following four year courses are open to entering students: general, college preparatory, vocational home economics, and industrial arts.

c. St. Francis High School. This is a Catholic high school for girls with an enrollment of about 185. The majority of its students enter from the four Catholic elementary schools of Lafayette. About ten per cent of its girls come from Catholic elementary schools of other communities and a few of its students enter from the public elementary schools of Lafayette and other communities. The general, college preparatory, and commercial courses are offered, all being four year courses.

2. Means of securing the data. The writer, assisted by two other teachers, secured almost all of the data personally from the school records in the principals' offices of the Lafayette schools, both elementary and high, posting them directly to small card record forms used for each pupil,

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2 The principal of the West Lafayette High School stated in an interview with the writer that of the June, 1931, graduating class fifty seven per cent entered Purdue the following Fall.
Records in the county superintendent's office were referred to in obtaining the marks in eighth grade arithmetic and eighth grade average scholarship for pupils entering the high schools from the rural elementary schools. In some cases the city superintendent's records had to be consulted to secure the marks in eighth grade arithmetic. For a small percentage of cases the writer obtained the eighth grade marks in average scholarship and arithmetic from a teacher or principal of the school, who copied the data from the principal's records to a sheet prepared by the writer. Twenty-two elementary and junior high school principals of schools outside of Lafayette contributed this information.

3. Description of the data.

a. The subjects of the study. All pupils enrolled in first year algebra, both 9B and 9A, in Jefferson, West Lafayette, and St. Francis High Schools during the first semester of the school year 1931-1932 were taken as subjects for this study. They were all ninth grade pupils taking algebra as a required subject of their course, with the exception of a few post graduates and others electing the work, and a small per cent of repeaters, who were classified as sophomores or juniors. Because of incompleteness of data, records of nine pupils, five girls and four boys, were excluded. The semester marks in algebra of these nine were A for two girls, B for two girls, C for one girl and two boys, and D for two boys.
b. Semester marks in algebra. Only the final semester marks given by the eight algebra teachers of the 344 pupils of this study were tabulated. The constituents of the marks reported by the various teachers were not questioned. The systems of marking in the three schools, although not identical, are basically the same. In each case four marks described in terms of per cent are employed. A represents 90 to 100 per cent; B, 80 to 90 per cent; C, 70 to 79 per cent; and D, the failing mark, anything below 70 per cent. In two of the schools conditions are sometimes given. Since these conditions can be removed only by additional work and a passing examination, they were counted as failures at the end of the first semester and rank as failures in this study.

c. Intelligence quotients. In all three high schools the Terman Group Test of Mental Ability was administered to ninth grade pupils during the first semester of the school year. However, the test was not given at the same time in each instance. The writer assumed, on the basis of reported studies, that the three or four months difference in time would influence the I.Q.'s only slightly. Investigations\(^3\) by Garrison, Kuhlman, Burt, Root, Rugg, and Wallin, published in 1921, indicate but small fluctuations in I.Q. on retests whether the interval is short or long. Terman's\(^4\)


\(^4\) Ibid., p. 32.
findings are in agreement with those of the above named investigators. Thorndike\(^5\) in summarizing the results of a study he conducted to determine the relation between intelligence test scores made by 8609 students of the ninth, tenth, and eleventh grades in May, 1922, and in May, 1923, writes: "Whenever repeated measures have been made over an interval of a year or more upon the same individuals initially fourteen or fifteen, there has been a marked improvement.-- Our gain may be set as equivalent to at least ten months of mental age." These findings do not differ widely from those reported by Terman and Garrison, who found the average change in I.Q. to be 4.5 and 5.4, respectively. Reference to tables prepared by Inglis\(^6\) will show that for individuals chronologically fourteen or fifteen an increase of ten months in mental age corresponds to an increase in I.Q. of but five or six points.

Slight invalidations of the I.Q. scores may be due to two factors. First, the tests were not administered by the same person, and second, the boys and girls, coming from a number of different school systems, may not have been "test

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wise" to the same degree. Failure to comply with a requirement set up by Colvin for validity of test scores is sometimes cited as a source of non-validity of test results.

"Tests are valid only within a group who have had identical or very similar opportunities for gaining familiarity with the materials of the test, and who have not only had the same opportunity to learn, but the same desire to learn." This objection is largely overcome by the fact that all of the pupils have come up through the elementary schools and have been admitted into high school.

d. **Chronological age.** The chronological ages employed in the analysis of the problem were those as of September 15, 1931.

e. **Mental age.** The mental ages of the subjects of this investigation were computed by means of Inglis Intelligence Quotient Values. The intelligence scores used were those made on the Terman test, and the chronological ages were those as of September 15, 1931. Since the I. Q. was regarded as constant, the mental ages thus determined were considered as those of September 15, 1931.

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9 A. Inglis, op. cit., p. 8.
f. **Eighth grade achievement in arithmetic.** The averages of the two final semester marks in eighth grade arithmetic for the pupils of this study were taken as the measures of eighth grade achievement in arithmetic.

g. **Eighth grade average scholarship.** The measures of eighth grade average scholarship were obtained by finding the average of each pupil's semester marks in all the subjects he studied during the entire eighth grade.

h. **Occupation of the parents.** The classification of occupations employed here is that used by Book in his state-wide mental survey of Indiana high schools.\(^\text{10}\) Thus the pupils of the present study were grouped into seven divisions according to the occupation of the parents; namely, professional class, clerical workers, salesmen and clerks, skilled artisans, business executives and foremen, day laborers, and farmers. In twenty-six cases information on this point was not available, reducing the total number of cases to 318.

i. **Per cent of absence.** In finding the per cent of absence the writer used ninety as the divisor although the actual number of days each of the three schools was in session during the semester was not exactly ninety, but near it.

B. Techniques Used in Treatment of Data

The relationship between semester marks in first year algebra and each of the other factors of this study was measured statistically by means of the coefficient of mean square contingency. Then in order to compare the adequacy of this coefficient of correlation with that of other more commonly used and more generally accepted statistical measures of relationship, the Pearson product-moment coefficient of correlation and the correlation ratio were computed for some of the factors. The product-moment coefficient was calculated in two slightly different ways, first, from the raw scores, and second, from the frequency table.

1. The coefficient of mean square contingency. Since the coefficient of mean square contingency has not been employed frequently in research and experimental studies, the writer considered a brief description and explanation of this statistical tool appropriate. The coefficient of mean square contingency, developed by Karl Pearson,\(^{11}\) is a measure of correlation, a measure of the relationship existing between

\[^{11}\text{Basil Orval Johnson, A Study of the Methods of Research, the Techniques of Collecting Data, the Statistical Methods and Methods of Presentation Used in Researches in Education, Master's Thesis, Contributions of the Graduate School, Number 67, Indiana State Teachers College, 1932, p. 20.}\]

some defined factor or trait and another factor or trait. The fundamental principle underlying the theory of contingency is a "comparison of the frequency of association (number of cases) actually found in each cell of a contingency table with the frequency of association which we should expect to find in the cells if the traits considered were completely unrelated (independent)." In other words, the contingency method is based upon the theory of probability.

Yule, Garrett, Elderton, Holzinger, and other authors of texts on statistics in education advocate the use of the contingency method when the regression is not linear or when the facts are given in a non-quantitative form of more than four divisions. Kelley, however, believes that the coefficient of mean square contingency has not demonstrated itself, beyond cavil, to be generally serviceable.

The contingency coefficient, C, gives simply the degree of the relation of the two traits associated; whether the correlation is positive or negative must be determined from

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the contingency table. Moreover, C varies in value, approaching 1.000 as the number of classes is increased to infinity. In the derivation of the formula for C integral calculus is used, and hence the assumption that there is an infinite number of groups is made. Yule has constructed the following table showing the maximum value of C for various groupings:

When the number of classes = 2 C cannot exceed .707
- " " " " " = 3 C " " .816
- " " " " " = 4 C " " .866
- " " " " " = 5 C " " .894
- " " " " " = 6 C " " .913
- " " " " " = 7 C " " .926
- " " " " " = 8 C " " .935
- " " " " " = 9 C " " .943
- " " " " " = 10 C " " .949

It is commonly agreed that, in spite of its defects, the contingency method is always valuable in making a preliminary analysis of a table, especially if a very accurate measure of correlation is not desired. C is also of great value in the analysis of many problems in psychology in which the relation between various attributes of individuals or things is sought.

The coefficient of mean square contingency is practically equivalent to r, the Pearson product-moment coefficient, when: (1) the grouping is relatively fine--five by five-fold or finer; (2) the number of cases is large; (3) it is known,
or there is justification for the assumption, that the traits being correlated are normally distributed. Pearson has worked out a correction, or adjustment, for data which fail to meet the first and third of the above mentioned conditions. For a five by five-fold or finer classification the correction is usually small and may be disregarded if only an approximation of \( r \) is sought. For a four by four-fold or coarser classification the correction should always be made. There is yet another difficulty in the matter of grouping, for too fine a grouping may give a less accurate result than a less fine one. Elderton lays down a rule that may be followed somewhat broadly. When the material can be divided into six (or less) classes, equal or approximately equal frequencies yield better results than equal ranges, but when there are more than six classes equal ranges should be taken.

In the solution of a problem by the contingency method the tabulation of the data is similar to the method used in constructing a correlation table. After the table is built in accordance with the rule stated in the preceding paragraph, the coefficient of mean square contingency may be found by

K. J. Holzinger, op. cit., p. 274.
G. U. Yule, op. cit., p. 66.

18 W. P. Elderton, op. cit., p. 201

19 See Appendix, pp. 52-56, for a complete model of a correlation computed by the contingency method.
means of the following formula:

\[ C = \sqrt{\frac{\phi^2}{1+\phi^2}} = \sqrt{\frac{S - 1}{S}} \]

in which \( S = \sum \left( \frac{f_{xy}^2}{f_x f_y} \right) \)

or in words, \( S \) is the sum of the quotients obtained by dividing the square of the frequency of each cell by the product of the total frequencies of the row and the column in which the cell occurs.

The finding of the probable error is a tedious process. In lieu of the probable error another device may be used to determine the significance of the correlation found. \( C \) is to be considered significant only when \( \phi^2 \), which equals \( S - 1 \), differs "sensibly" from

\[ \frac{c - 1}{N} \pm 0.67449 \sqrt{\frac{2c}{N}} \]

In this expression \( c \) is the number of cells in the contingency table.

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22. K. J. Holzinger, op. cit., p. 278.

IV. DISTRIBUTION OF ALGEBRA MARKS IN FIRST YEAR ALGEBRA

A. Class Size

The 344 pupils whose records were used in this study were enrolled in thirteen different classes under eight different teachers. There were eight classes of 9B algebra with five teachers. The number of pupils who completed the course was 239, approximately two-thirds boys and one-third girls. The sizes of the classes ranged from nineteen to thirty-seven with an average of thirty pupils. There were five classes of 9A algebra with three teachers. The number of pupils who completed the course was 114, again approximately two-thirds boys and one-third girls. The classes varied in size from sixteen to twenty-eight with an average of twenty-three pupils. The average size of 9B and 9A classes combined was twenty-seven.

The majority of the pupils were sectioned early in the semester into classes designated as good, average, and poor pupils. Hence, although the classes varied considerably in size, the writer made no account of class size in the distribution of marks.

B. Distribution of Marks in First Year Algebra for the Entire Group

The distribution of semester marks for the pupils of this study in 9B and 9A algebra combined is shown in Table I. These marks were given by eight different mathematics teachers.
whose standards of marking were not identical. The writer prepared a paper of solutions to six algebra problems involving fractions and fractional equations, some solutions being free from errors and others having typical pupil errors. Each of the eight teachers was asked to mark the paper on the basis of one hundred per cent. No specific directions for marking accompanied the papers. The marks on the eight papers varied from thirty-eight to seventy-five, the average being fifty-three. The writer recognizes the fact that eight is too small a number from which to draw any conclusion as to the reliability of teachers' marks.

TABLE I

SEMESTER MARKS IN 9B and 9A ALGEBRA

<table>
<thead>
<tr>
<th>Marks</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Num- Per cent</td>
<td>Num- Per cent</td>
<td>Num- Per cent</td>
<td>Num- Per cent</td>
<td>Num- Per cent</td>
</tr>
<tr>
<td>Boys</td>
<td>38 18</td>
<td>46 22</td>
<td>67 32</td>
<td>59 28</td>
<td>210 100</td>
</tr>
<tr>
<td>Girls</td>
<td>43 32</td>
<td>47 35</td>
<td>26 19</td>
<td>18 13</td>
<td>134 99</td>
</tr>
<tr>
<td>Total</td>
<td>81 24</td>
<td>93 27</td>
<td>93 27</td>
<td>77 22</td>
<td>344 100</td>
</tr>
</tbody>
</table>

The percentage of pupils who failed first year algebra is very high, yet this percentage of twenty-two does not differ widely from that given in other studies of the distribution of marks.
In 1913 Rounds and Kingsbury found that, out of a total enrollment in mathematics of 24,404 pupils in forty-six high schools scattered throughout the United States, only 75.25 per cent passed. The lowest percentage of passing marks was 59.5 per cent and the highest was 83.8 per cent. Of all the school subjects in these schools mathematics did not once make the best showing.

Four years later Bliss collected data from New Jersey schools. The average of the mathematics failures, including both algebra and geometry, for the schools of thirteen superintendents was 16.5 per cent. From among thirty-three teachers in ten schools only one reported one per cent failure while sixteen reported failures ranging from 20 to 39.5 per cent. Eight of these gave between 33 and 39.5 per cent failing marks.

Rogers reported in a study of the percentage of subject failures in the Chicago Senior High Schools, for 9B and 9A mathematics, failures of 16.5 and 18.6 per cents respectively. The results were based on the marks received by 59,218 pupils in twenty-four high schools.


In 1925 Schreiber\textsuperscript{27} conducted a study of 160 pupils in eight different classes of first year algebra in which there were almost twice as many boys as girls. The percentage of failure was 16.8.

More recently published than the previously quoted studies is that of Betz.\textsuperscript{28} His results are based on about 2,000,000 ratings tabulated during a survey of New York high schools. Twenty-two or twenty-three out of every one hundred failed in algebra.

In a thesis submitted for a master's degree at the University of Illinois, Busby\textsuperscript{29} makes a report of 725 students enrolled in algebra 9B and 9A in the public schools of Danville, Illinois. The average per cent of failure for both boys and girls was thirteen; for boys only it was 16.3 per cent, and for girls only, 8.9 per cent.

C. Distribution of Algebra Marks According to Sex

In this study the number of boys was 210 and the number of girls was 134, or sixty-one and thirty-nine per cents respectively. Only thirteen per cent of the girls failed while twenty-eight per cent of the boys failed. The

\begin{thebibliography}{9}
\bibitem{27} Edwin W. Schreiber, "A Study of the Factors of Success in First Year Algebra," \textit{Mathematics Teacher}, XVIII (Feb., 1925), pp. 75-78.
\end{thebibliography}
distributions of marks for boys only, for girls only, and for the entire group are presented in Figure 1.

These results are not in agreement with those reported by Thorndike. He compared the scores of 364 boys and 321 girls.

girls who were given the forty element I.E.R. test to quadratics and concluded that the sexes are of approximately equal ability.

In February, 1920, Jackson 31 collected data from 110 high schools in Michigan. He found that 25.6 per cent of the boys failed in the first semester of ninth year algebra. He states nothing concerning the percentage of girls who failed.

Three or four years ago Pease 32 constructed a test of 770 units, consisting of one or more representative problems for each of the identified learning units in algebra. The test was given as soon as that particular part of the text corresponding to the test had been completed. The high schools cooperating constituted a good sampling of first year algebra pupils in the Middle West. The girls excelled in every test except that of horizontal addition of literal numbers. The average boy made 163.77 errors and the average girl, 142.81 errors.

D. Summary

The results set forth in this section seem to verify these statements:

1. The distribution of semester marks in ninth year algebra presents approximately equal percentages of those receiving the various marks.


2. There is a high percentage of failures among ninth year algebra pupils.

3. This high percentage of failures does not differ widely from those reported in previous studies.

4. The percentage of boys who failed is slightly more than twice the percentage of girls who failed.

5. Other studies show that fewer girls than boys fail.
V. THE RELATIONSHIPS BETWEEN ALGEBRA MARKS AND EACH OF THE OTHER FACTORS AS MEASURED BY THE COEFFICIENT OF MEAN SQUARE CONTINGENCY

A. The Coefficient of Mean Square Contingency

The problem of this section is the calculation of the relationships between semester marks in first year algebra and each of the other factors; namely, mental age, I. Q., chronological age, eighth grade arithmetic, eighth grade average scholarship, occupation of the parents, and per cent absence. The relationships are determined by means of the coefficient of mean square contingency. For each set of factors C was calculated for the entire group, for boys only, and for girls only.

1. The values of the coefficients of mean square contingency. Fifteen of the twenty-three coefficients of mean square contingency are between .40 and .50. Three of the coefficients, those for algebra marks and chronological ages, and three for algebra marks and per cent of absence range from .33 to .40, while only two coefficients are less than .33. Those for algebra marks and occupations of the parents are .20 and .23.

Mental ages and I. Q.'s were also correlated. The coefficients vary from .787 to .948.

The coefficients of mean square contingency along with other results to be discussed later are presented in Table II.

The values of C for the three groupings of each set of
<table>
<thead>
<tr>
<th>Variables</th>
<th>Group</th>
<th>Size</th>
<th>C</th>
<th>( \phi^2 )</th>
<th>( \frac{c-1 + .6745\sqrt{\frac{\phi^2}{n-1}}}{N} )</th>
<th>r-Raw Score</th>
<th>r-Freq.Dist.</th>
<th>( n_{yx} )</th>
<th>( \frac{\sqrt{N}}{.6745} \cdot \frac{\sqrt{n^2-r^2}}{2} )</th>
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<tr>
<td>Alg. Marks- I. Q.'s</td>
<td>All</td>
<td>8x4</td>
<td>.432</td>
<td>.475</td>
<td>.229</td>
<td>.090 ± .016</td>
<td>.379 ± .03</td>
<td>.437</td>
<td>3.97</td>
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<td>All</td>
<td>7x4</td>
<td>.429</td>
<td>.473</td>
<td>.220</td>
<td>.078 ± .015</td>
<td>.379 ± .03</td>
<td>.329 ± .03</td>
<td>.437</td>
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<td>Boys</td>
<td>7x4</td>
<td>.447</td>
<td>.495</td>
<td>.249</td>
<td>.129 ± .024</td>
<td>.429 ± .04</td>
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<td>.493</td>
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<td>.321</td>
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<td>.337</td>
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<td>.357</td>
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<td>M. A.'s-</td>
<td>Girls</td>
<td>7x7</td>
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<td>.358 ± .050</td>
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</tbody>
</table>

*The numbers in this column refer to the number of columns and the number of rows in the contingency tables.

**The values in this column must differ "sensibly" from the values in column \( \chi^2 \) in order that the \( C \)'s may be considered significant.

***When the values in this column are 2.50 or greater, the \( \eta_{yx} \)'s are better measures of the relationship between the two variables than are the \( r \)'s.
factors 'differ slightly, the difference being less than .10 in all cases except that of algebra marks and occupations of the parents. Between these two factors for the entire group C is .197, for boys only it is .226, and for girls only it is .443. The C's are slightly higher for girls only than for boys only in four of the correlations and slightly lower for girls than for boys in three cases. In four calculations the C's for the entire group are smaller by a few hundredths than the C's for either boys or girls; three times they lie between the C's for boys and for girls; and once C for the entire group is larger than C for either boys or girls.

Algebra marks for the entire group show approximately equal coefficients of contingency with eighth grade arithmetic, eighth grade average scholarship, I. Q.'s, and mental ages. The coefficients for these factors are .453, .446, .429, and .404 respectively. When the boys-only groups are used, the C's for the same factors are .483, .486, .447, and .422. The girls-only groups yield C's of .439, .408, .493, and .480. Mental ages and I. Q.'s correlate higher than any of the other sets of factors. The coefficients for the entire group, for boys only, and for girls only are .848, .831, and .808 respectively.

2. The effect of the size of the contingency table upon the values of the coefficients of mean square contingency. The size of the contingency tables for algebra marks and each of the other factors varies from a four by four-fold table
to a four by eight-fold one. With identical data the finer classification yields very slightly larger coefficients than the coarser classification. The coefficient for algebra marks and I. Q.'s classified into an eight by four-fold table is .432 while in a seven by four-fold table it is .429. Algebra marks and per cent of absence for a six by four-fold classification show a coefficient of .360; for a four by four-fold classification, one of .337. When mental ages and I. Q.'s are thrown into a six by seven grouping, C is .787; when thrown into an eight by eight grouping, C is .848.

3. Corrections for the coefficients of mean square contingency. Corrections for the coefficients of mean square contingency are recommended for a four by four-fold or coarser classification. The various authors of texts on statistics already quoted say that the corrections for a five by five-fold or finer classification are usually small and need not be made. Although the writer used some classifications finer than a four by four-fold one, she calculated corrections for each coefficient in order to compare the raw coefficient and the corrected coefficient, \( cC \), with the Pearson product-moment coefficients of correlation and the correlation ratios for some of the factors.

Twenty-six of the twenty-seven differences between C and \( cC \) range from .023 to .093; one is .133. C for algebra

33 The table set-ups, the values of C and of the corrected C, \( cC \), and the significance of C are presented in the Appendix, pp. 57-82.
marks and per cent of absence for the entire group in a four
by four-fold classification is .337, while $cC$ is .470. Two
factors probably account for this rather large difference.
First, the classification is coarse, four by four-fold, and
second, the frequencies in the first and the other three
columns differ widely. They are 257, 33, 33, and 21. The
first number is large because the records of all those who
were perfect in attendance as well as those who were absent
two or less per cent are placed in the same category. In
another table set-up, six by four, the zero-per-cent absences
constitute a separate column. Here $C$ is .360 and $cC$ is .424,
a difference of only .064 as compared with that of .133 for
the four by four grouping.

The same two factors, algebra marks and per cent of
absence, for girls only, yield a coefficient of .435 with a
corrected coefficient of .525, a difference of .090. Algebra
marks and eighth grade average scholarship for girls only
show $C = .408$ and $cC = .501$, a difference of .093. In both
these cases (1) the total frequency is small, 134; (2) the
classifications are coarse, five by four and four by four
respectively; and (3) the frequencies of the columns present
considerable variance.

An examination of the tables and of the values of the
coefficients and the corrected coefficients will verify the
following statement. The corrections are smaller for the
finer classification and the larger total frequency than for
the coarser classification and the smaller total frequency.
Only one exception—a practically negligible one—to the above statement is to be found among all the corrections. C for algebra marks and per cent of absence for boys, involving a total frequency of 210, is .357 and $c_C$ is .419, a difference of .062. C for the same factors for the entire group, a total of 344, is .360 and $c_C$ is .424, a difference of .064. Although the size of the table is the same in each case, the frequencies of the columns for the 344 group show far greater inequality than those for the 210 group.

In all except one set of factors, that of algebra marks and occupations, the variation of the $c_C$'s among the different groupings is less than that of the raw C's. In other words, the values of the $c_C$'s for each set of factors are more nearly equal to each other than are the uncorrected C's.

4. The significances of the coefficients of mean square contingency. As explained earlier in this study, the results obtained by the contingency method are not significant unless $\phi^2$, used in the computation of C, differs "sensibly" from $c - 1 + .6745 \frac{2c}{N}$.

In Table II the values of these measures are presented. The two values differ "sensibly" in all but three contingencies. Hence, all the coefficients may be considered significant but those between algebra marks and chronological ages for boys, algebra marks and chronological ages for girls, and algebra marks and occupations of the parents for girls.
B. Summary

The findings reported in this section seem to justify the following conclusions:

1. Conclusions based upon the data for the entire group of both boys and girls.
   a. The relationship between algebra marks and eighth grade arithmetic is very slightly higher than that between algebra marks and any other factor.
   b. Algebra marks show approximately equal coefficients of contingency with eighth grade arithmetic, eighth grade average scholarship, I. Q.'s, and mental ages.
   c. The lowest relationship is that between algebra marks and occupations.
   d. The corrected coefficients yield practically the same results as those stated in the preceding three points.
   e. All of the coefficients are significant.

2. Conclusions based upon the data for boys only:
   a. The highest relationship exists between algebra marks and eighth grade average scholarship.
   b. Algebra marks show approximately equal coefficients of contingency with eighth grade average scholarship, eighth grade arithmetic, I. Q.'s, and mental ages.
c. The lowest relationship exists between algebra marks and occupations.
d. The corrected coefficients destroy slightly the approximate equality of relationships mentioned under b.
e. All of the coefficients except that between algebra marks and chronological ages are significant.

3. Conclusions based upon the data for girls only:

a. The highest relationship exists between algebra marks and I. Q.'s.
b. Algebra marks show approximately equal relationships with I. Q.'s, mental ages, eighth grade arithmetic, occupations of the parents, and per cent of absence, and only slightly less relationships with eighth grade average scholarship and chronological ages.
c. The lowest relationship is that between algebra marks and chronological ages.
d. The corrected coefficients yield practically the same results as those given in points a, b, and c, the correction showing the greatest increase over the raw coefficient for algebra marks and eighth grade average scholarship.
e. Two of the coefficients of contingency are not significant--those for algebra marks and
chronological ages, and algebra marks
and occupations of the parents.

4. The values of the coefficients of contingency of
each set of factors for the entire group, for boys only, and
for girls only differ but slightly, with one exception—
algebra marks and occupations of the parents.

5. With identical data the finer classification
yields very slightly higher coefficients of contingency than
the coarser classification.

6. The corrections for the coefficients of contingency
vary with each of three factors.
   a. The finer classification yields a smaller
correction than the coarser classification.
   b. The larger total frequency yields a smaller
correction than the smaller total frequency.
   c. Close agreement among the frequencies of the
columns or rows yields a smaller correction
   than wide discrepancies among the frequencies.

7. The corrections tend to equalize the coefficients
of contingency for the entire group, for boys only, and for
girls only for any one set of factors.
VI. THE RELATIONSHIPS BETWEEN ALGEBRA MARKS AND CERTAIN OF
THE OTHER FACTORS AS MEASURED BY THE PEARSON
PRODUCT-MOMENT COEFFICIENTS OF CORRELATION
AND THE CORRELATION RATIOS

The Pearson product-moment coefficients of correlation
and the correlation ratios were computed for algebra marks
and some of the other factors in order that the coefficients
of mean square contingency might be compared with these two
more widely used measures of relationship.

A. The Pearson Product-Moment Coefficient of
Correlation and the Correlation Ratios

Two different methods were used in computing the
product-moment coefficients of correlation. The coefficients
recorded under column "r--raw score" of Table II, pp. 25-27,
were calculated by means of the following formula: 34

\[ r = \frac{XY - N \bar{M}_x \bar{M}_y}{\sqrt{\left( X^2 - N \bar{M}_x^2 \right) \left( Y^2 - N \bar{M}_y^2 \right)}} \]

For the columns "r--freq. dist." and "r_{yx}" the values
were obtained by means of Holzinger's combination form for
computing the correlation coefficients and the correlation
ratios. 35

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34 K. J. Holzinger, Statistical Methods for Students in

An examination of Table II reveals the existence of quite close agreements between the r's for any one set of factors computed by the two methods. In the case of algebra marks and I. Q.'s for all pupils, r computed from raw scores is .379 and from a frequency distribution, .329. However, the value from a frequency distribution cannot always be accepted as a true measure of the relationship between the two variables. The correlation ratio, \( \eta_{yx} \), for these variables is .437 and is a better measure of the relationship if the regression of Y on X is non-linear.

The linearity test applied in this problem was derived from a formula given by Rietz.\(^36\) When the value of
\[
\frac{\sqrt{N}}{.6745} \cdot \frac{1}{2} \sqrt{\eta^2 - r^2} < 2.50
\]
r may be considered an adequate measure. In other cases \( \eta_{yx} \) is the better measure of the relationship between the variables being correlated.

Since the value of the factor given above is 3.97, the correlation ratio of .437 is the better of the two measures. It corresponds quite closely to the r-raw score value of .379.

B. Correlation Coefficients Reported in Other Studies

1. Correlations between algebra marks and I. Q.'s.
Many studies have been made to determine the relationship between algebra marks and I. Q.'s. Only a few of these studies conducted

within the last decade will be reviewed here.

Austin\textsuperscript{37} reports several correlations between algebra marks and scores on the Otis Intelligence Test. His study extended over the period from February, 1921, to February, 1924. The number of freshmen enrolled in algebra during five different semesters varied from 176 to 377 with an average of 258. The r's are $0.54 \pm 0.03$, $0.54 \pm 0.04$, $0.40 \pm 0.03$, $0.50 \pm 0.03$, and $0.46 \pm 0.03$.

A correlation of $0.60 \pm 0.06$ between algebra marks made by fifty freshmen in Monticello High School, Monticello, Indiana, during the first semester of the school year 1925-1926 and their mean percentile rank in intelligence is reported by Elder.\textsuperscript{38}

In a master's thesis Flood\textsuperscript{39} gives the results of a study of the relationships between several factors. For about seventy-five 9B algebra pupils of West High School, Akron, Ohio, the correlation between Otis Intelligence scores and achievement in algebra was found to be $0.571 \pm 0.052$.


\textsuperscript{38}Harry E. Elder, "Percentile Rank in Intelligence as a Prognosis of Success in Algebra," School Review, XXXIV (Sept., 1926), p. 545.

\textsuperscript{39}John Wm. Flood, A Study to Determine the Degree to Which Achievement in Algebra and English is Dependent Upon Intelligence by Determining the Correlations Existing Between the Scores on the Hotz Algebra Tests, the Pressey Diagnostic English Tests, the Otis Intelligence Tests, and Teachers' Marks in English and Algebra, Master's Thesis, Ohio State University, 1928.
The records of 406 students who took beginning algebra during a period of three years were analyzed by Mensenkamp\textsuperscript{40} to determine the correlation between algebra, arithmetic, and I.Q.'s. The correlation for algebra and I.Q.'s is $0.42 \pm 0.027$.

Lewman\textsuperscript{41} reports in his master's thesis a correlation of $0.605 \pm 0.036$ between I.Q.'s on the Terman test and marks in algebra. He secured his data from Bridgeton High School, Bridgeton, Indiana.

Grover\textsuperscript{42} found a coefficient of correlation of $0.61 \pm 0.06$ between I.Q.'s on the Terman test and achievement test scores on the Columbia Research Bureau Algebra Test. Only seventy-one pupils of Oakland Junior High School, Oakland, California, were included in this study.

A collection of twenty-six $r$'s is presented by Symonds.\textsuperscript{43} He compiled his list from studies reported by Weglein, Crathorne, Rogers, Buckingham, Monroe, Proctor, Weglein, Crathorne, Rogers, Buckingham, Monroe, Proctor, Weglein, Crathorne, Rogers, Buckingham, Monroe, Proctor, Weglein, Crathorne, Rogers, Buckingham, Monroe, Proctor, Weglein, Crathorne, Rogers, Buckingham, Monroe, Proctor.

\textsuperscript{40}L. E. Mensenkamp, "Ability Classification in Ninth Grade Algebra," \textit{Mathematics Teacher}, XXII (Jan., 1929), p. 42.

\textsuperscript{41}John F. Lewman, A Prognostic Study of Success in High School Based on Eighth Grade Marks and an Intelligence Test, Master's Thesis, Indiana State Teachers College, 1931.

\textsuperscript{42}C. C. Grover, "Results of an Experiment in Predicting Success in First Year Algebra in Two Oakland Junior High Schools," \textit{Journal of Educational Psychology}, XXIII (April, 1932), p. 311.

\textsuperscript{43}Percival Mallon Symonds, \textit{Special Disability in Algebra}, Contributions to Education, No. 132 (New York: Teachers College, Columbia University, 1923), p. 64.
Thorndike', and Mann. These r's range from .58 to .90. His final estimate of r for algebra and intelligence is .70 for high school freshmen.

2. Correlations between algebra marks and eighth grade arithmetic marks. Schreiber\(^44\) made a study of the records of 160 pupils, 39 per cent girls and 61 per cent boys, enrolled in eight different classes of first year algebra. He found the correlation between success in algebra and intelligence to be .52.

For these same two variables Mensenkamp\(^45\) and Lewman\(^46\) report r's of .54 ± .024 and .588 ± .037 respectively.

3. Correlations between algebra marks and eighth grade average scholarship. Lewman also states the correlation between the average of eighth grade marks and algebra 9 for the pupils of his study. The correlation is .567 ± .038.

4. Correlations between algebra marks and chronological ages. Of the studies the writer examined, she found only one that gave specifically the correlation between algebra marks and chronological ages for pupils in their ninth year. This one is Lewman's study referred to in previous sections. The r is -.267 ± .052.

---


\(^45\)L. E. Mensenkamp, op. cit., p. 42.

5. Correlations between marks and attendance.

Halberstadt,\textsuperscript{47} dean of boys of Gerstmeyer Technical High School, Terre Haute, Indiana, determined the correlation between attendance and the average of teachers' marks to be $-0.347 \pm 0.03$. The correlation for attendance and algebra marks only was not given.

C. Comparisons Between Correlations Reported by Others and Those Found in This Study

The correlations presented in the reviews are not in perfect agreement with those found by the writer. The majority of the r's for algebra marks and I.Q.'s in the studies conducted within the last ten years diverge upward less than 0.15 from the correlation ratio, 0.437, which the writer found to be a better measure of the relationship than r for these variables.

The correlation coefficients reported by others for algebra marks and eighth grade arithmetic are less than 0.10 larger than the writer's r's.

Again, for algebra marks and eighth grade average scholarship the r's of this study are about 0.10 lower than the correlation coefficient reported by Lewman.

For algebra marks and chronological ages the correlation in the present study is slightly lower than that found by Lewman; in this case, however, the correlation ratio, a more nearly adequate measure of the relationship, is slightly higher than Lewman's r of $-0.267 \pm 0.052$.

There is a very close agreement between the correlation coefficient for algebra marks and attendance in this study and in an earlier study.

D. Summary

The results presented in this section seem to justify the following statements:

1. The correlation coefficients computed by means of the formula for raw scores and by means of a frequency distribution are generally equivalent.

2. When the linearity test shows the correlation ratio to be a better measure of the relationship between the variables than is the correlation coefficient, then there is very close agreement between the correlation coefficients computed from raw scores and the correlation ratio.

3. The relationships between algebra marks and each of the variables—IQ's, mental ages, eighth grade arithmetic, eighth grade average scholarship, chronological ages, and per cent of absence—are generally low, ranging from .30 to .50, but significant.

4. The relationships found in this study are somewhat lower than those reported in other studies for these variables: algebra marks and IQ's, algebra marks and eighth grade arithmetic, algebra marks and eighth grade average scholarship.

5. There is very close agreement between the relationships found in this study and those reported in earlier
studies for algebra marks and chronological ages and algebra marks and per cent of absence.
VII. COMPARISONS OF COEFFICIENTS OF MEAN SQUARE CONTINGENCY
WITH PEARSON PRODUCT-MOMENT COEFFICIENTS
OF CORRELATION AND CORRELATION RATIOS

A. Contingency Coefficients and Correlation Ratios

The Pearson product-moment coefficients of correlation and correlation ratios were computed by means of Holzinger's frequency distribution form, for algebra marks and each of six factors; namely, mental ages, I. Q.'s, eighth grade arithmetic, eighth grade average scholarship, chronological ages, and per cent of absence. In five of these correlations the number of cases is 344, the entire group of pupils; in the one for algebra marks and per cent of absence it is 134, the girls only. The sizes of the contingency tables are eight by four, seven by four, five by four, and four by four. The 134 cases occur in a five by four table.

From the two four by four-fold tables, algebra marks and eighth grade arithmetic and algebra marks and eighth grade average scholarship, the coefficients of mean square contingency are a little smaller than the product-moment correlation coefficients. The corrected contingency coefficient for algebra marks and eighth grade arithmetic agrees more closely with the correlation coefficient and correlation ratio than does the raw C. In the case of algebra marks and eighth grade average scholarship the raw C, although lower in value

See Table II, pp. 25-27.
than the \( r \) or \( \eta_{yx} \), agrees more closely with the latter values than does the corrected \( C \).

In the other four sets of contingency coefficients, where the classification is finer than four by four-fold, the uncorrected or raw \( C \)'s agree more closely than the corrected \( C \)'s with the product-moment coefficients or the correlation ratio when the latter is a better measure than \( r \). This relationship holds true for the 134 cases as well as for the 344.

The differences between the \( C \)'s, or \( \eta \)'s when corrections are necessary as in a four by four table, and the \( r \)'s or \( \eta_{yx} \)'s are so small that the contingency method of computing the correlation may be used safely to secure a quite accurate measure of the relationship between two variables. If a calculating machine is used for the arithmetical operations, a correlation can be computed in considerably less time by the coefficient of mean square contingency method than by the frequency distribution or raw score formula methods for the Pearson product-moment coefficients of correlation computed without the aid of a correlation machine.

B. Summary

The analysis of results in this section seem to justify the following statements:

1. The coefficients of mean square contingency in a finer than four by four-fold table are slightly larger than the product-moment coefficients of correlation or the
correlation ratio when the latter is a more adequate measure of the relationship than is the product-moment coefficient.

2. The coefficients of mean square contingency in a four by four-fold classification are slightly lower than the product-moment coefficients of correlation or the correlation ratios.

3. For a finer than four by four-fold classification, the uncorrected coefficient of mean square contingency is a better measure of the relationship between two variables than is the corrected contingency coefficient.

4. When the classification is finer than four by four-fold, the uncorrected contingency coefficient is still the better measure of relationship between two variables for a relatively small number of cases, 134.

5. The coefficient of mean square contingency method of computing correlations may be used safely and advantageously to secure a quite accurate measure of the relationship between two variables.
VIII. THE PREDICTION OF SUCCESS IN ALGEBRA

The problem of this section is to determine how the school can interpret the results found in this study to guide its pupils and thus avert some failures. Since the coefficients of mean square contingency are practically equivalent to the product-moment coefficients of correlation, they could probably be used for prognostic purposes wherever the correlation coefficients are used. However, product-moment coefficients must be at least .90 in order that individual scores may be estimated with accuracy. Estimates based on r's of .40 are only eight per cent better than mere guesses, and those based on r's of .50, only thirteen per cent better than mere guesses. Since the C's and r's found for algebra marks and the various other factors scarcely exceed .50, the writer did not set up any regression equation for the prediction of algebra marks when any one or all of the other variables are known.

One other method of interpreting the data secured for this study may be used. The data may be thrown into a probability table which represents "the least technical of the procedures used in interpreting data in guiding students." Not being technical, the probability table is easily understood.


by high school pupils, and is therefore effective with them. The writer did not prepare probability tables from the data collected, but she believes that such tables set up from data collected over a period of years for the same school would be valuable aids in preventing some failures in ninth grade algebra.

The writer says "some" failures because innumerable factors enter into a pupil's success in any subject. Some of these factors lie with the pupil himself and many of them lie with his teacher, his parents, and his home. Until complete diagnoses can be made of all the factors contributing to success, there will probably still be failures.

A. Summary

The discussion in this section may be summarized as follows:

1. Estimates of algebra marks made by means of a regression equation for algebra marks and any one of the other factors used in this study would be only eight to thirteen per cent better than mere guesses.

2. Probability tables, not being technical in nature, may prove of some value in guiding pupils.

3. More thorough analyses of factors contributing to success in algebra are required to avert school failures.
IX. CONCLUSION

The data presented in this study seem to justify the following conclusions:

1. Conclusions based upon the data for the entire group of boys and girls:
   a. Approximately equal percentages of pupils receive each of the various marks.
   b. There is a high percentage of failures among ninth year algebra pupils, nearly one-fourth of the pupils failing.
   c. The highest relationship between algebra marks and any of the other factors is that between algebra marks and eighth grade arithmetic.
   d. The lowest relationship between algebra marks and any of the other factors is that between algebra marks and occupations.
   e. There are approximately equal relationships between algebra marks and each of the factors—eighth grade arithmetic, eighth grade average scholarship, I. Q.'s, and mental ages.
   f. All of the relationships are low, between .20 and .50, but significant.

2. Conclusions based upon the data for boys only:
   a. More than one-fourth of the boys fail in ninth year algebra.
   b. The percentage of boys who failed is slightly
more than twice the percentage of girls who failed.

c. The highest relationship between algebra marks and any other factor is that between algebra marks and eighth grade average scholarship.

d. The lowest relationship between algebra marks and any other factor is that between algebra marks and occupations.

e. There are approximately equal relationships between algebra and each of the factors—eighth grade average scholarship, eighth grade arithmetic, I. Q.'s, and mental ages.

f. All of the relationships except that between algebra marks and chronological ages are significant.

g. All of the relationships are low, between .20 and .50.

3. Conclusions based upon the data for girls only:

a. Two-thirds of the girls receive algebra marks of A or B, and slightly more than one-tenth receive failing marks.

b. Only one-half as many girls fail as boys.

c. The highest relationship between algebra marks and any of the other factors is that between algebra marks and I. Q.'s.

d. The lowest relationship between algebra marks and any of the other factors is that between
algebra marks and chronological ages.
e. There are approximately equal relationships between algebra marks and each of the factors—
I. Q.'s, mental ages, eighth grade arithmetic, occupations of the parents, and per cent of absence.
f. All of the relationships except those between algebra marks and chronological ages and algebra marks and occupations of the parents are significant.
g. All of the relationships are low, between .39 and .50.

4. Conclusions concerning the coefficient of mean square contingency:
   a. The values of the coefficient of mean square contingency for each set of factors for the entire group, for boys only, and for girls only differ but slightly, with one exception, algebra marks and occupations of the parents.
   b. With identical data the finer classification yields very slightly higher coefficients of contingency than the coarser classification.
   c. The corrections for the coefficients of contingency tend to equalize the coefficients for the entire group, for boys only, and for girls only for any one set of factors.
d. The corrections for the coefficients of contingency vary with each of three factors:

1) The finer the classification the smaller the correction.
2) The larger the total frequency the smaller the correction.
3) The closer the agreement among the frequencies of the columns or rows the smaller the correction.

e. The uncorrected coefficient of mean square contingency is practically equivalent to the Pearson product-moment coefficient of correlation or the correlation ratio for any two variables.

f. The coefficient of mean square contingency method of computing correlations may be used safely and advantageously to secure a quite accurate measure of the relationship between two variables.

5. The Pearson product-moment coefficients of correlation computed by means of the formula for raw scores and by means of a frequency distribution are generally equivalent.

6. Estimates of algebra marks from any of the other factors used in this study by means of regression equations would be only eight to thirteen per cent better than mere guesses.


X. APPENDIX

A. Complete Model of a Correlation Computed
   by the Contingency Method

TABLE III

ALGEBRA MARKS AND I. Q.'S FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>I. Q.'s Below 70</th>
<th>70-79.9</th>
<th>80-89.9</th>
<th>90-99.9</th>
<th>100-109.9</th>
<th>110-119.9</th>
<th>120-129.9</th>
<th>130-Above Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>13</td>
<td>27</td>
<td>21</td>
<td>16</td>
<td>3</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>11</td>
<td>27</td>
<td>30</td>
<td>14</td>
<td>9</td>
<td>1</td>
<td>93</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>4</td>
<td>16</td>
<td>24</td>
<td>28</td>
<td>17</td>
<td>1</td>
<td>93</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>8</td>
<td>21</td>
<td>20</td>
<td>21</td>
<td>5</td>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>13</td>
<td>49</td>
<td>84</td>
<td>106</td>
<td>57</td>
<td>27</td>
<td>5</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}} \\
S = 1.229441 \\
S - 1 = .229441 \\
C = .432 \\
C^2 = .229441 \\
\phi^2 = .229441 \\
\]

\[
c^C = \frac{C}{r_{xc} \cdot r_{yc}} \cdot \frac{c - 1 + .6745 \sqrt{2c}}{N} = .090 \pm .016 \\
\]

Therefore C is significant.
Calculations for Coefficients of Mean Square Contingency
Algebra Marks and I. Q.'s for all Pupils

Row 1 (A)                        Row 3 (C)                        
1 \times 49 = 0.020408            4 \times 3 = 1.333333
169 \times 84 = 2.011905         16 \times 13 = 1.230769
729 \times 106 = 6.877358        256 \times 49 = 5.224489
441 \times 57 = 7.736842         576 \times 84 = 6.857142
256 \times 27 = 9.481481         784 \times 106 = 7.396226
9 \times 5 = 1.800000           289 \times 57 = 5.070175

81 \left[ \begin{array}{l} 27.927794 \\ .344788 \end{array} \right]

Row 2 (B)                        Row 4 (D)                        
1 \times 13 = 0.076923            1 \times 3 = 0.333333
121 \times 49 = 2.469387         64 \times 13 = 4.923077
729 \times 84 = 8.678571         441 \times 49 = 9.000000
900 \times 106 = 8.490566        400 \times 84 = 4.761905
196 \times 57 = 3.438596         441 \times 106 = 4.160377
81 \times 27 = 3.000000          25 \times 57 = .438596
1 \times 5 = .200000            1 \times 27 = .037037

93 \left[ \begin{array}{l} 26.354043 \\ .283377 \end{array} \right]

77 \left[ \begin{array}{l} 23.654325 \\ .307199 \end{array} \right]

.344788 + .283377 + .294077 + .307199 = 1.229441 = S

.229441 = S - 1
Calculations (continued)

\[
C = \sqrt{\frac{S - 1}{S}} = \sqrt{\frac{.229441}{1.229441}} = .432
\]

Corrected \( C = cC = \frac{C}{r_{xc} \times r_{yc}} \)

The calculations for the corrections \( r_{xc} \) and \( r_{yc} \) are given on pages

\[
r_{xc} = .975
\]
\[
r_{yc} = .933
\]
\[
c^C = .475
\]

In order that \( C \) may be considered significant \( \phi^2 \) must differ "sensibly" from \( \frac{c - l \pm .6745 \sqrt{2c}}{N} \).

\[
\phi^2 = S - 1 = .229441
\]
\[
c = 32, \text{ the number of cells in the contingency table.}
\]
\[
\frac{c - l \pm .6745 \sqrt{2c}}{N} = .090 \pm .016
\]

Since .299 differs "sensibly" from .090 \( \pm \) .016, \( C \) may be considered significant.
<table>
<thead>
<tr>
<th>Group Frequency $f_x$</th>
<th>Area $f_x/N$</th>
<th>Cumulative Area</th>
<th>$\frac{1}{2}a^*$</th>
<th>Ordinates**</th>
<th>$z_s-z_{s+1}$</th>
<th>$\left(\frac{z_s-z_{s+1}}{N}\right)^2$</th>
<th>$\frac{N}{f_x}$</th>
<th>$\frac{N}{f_x}\left(\frac{z_s-z_{s+1}}{N}\right)^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>.009</td>
<td>.009</td>
<td>-.491</td>
<td>$z_1$ .024</td>
<td>-.024</td>
<td>.000576</td>
<td>114.6607</td>
<td>.066048</td>
</tr>
<tr>
<td>13</td>
<td>.038</td>
<td>.047</td>
<td>-.453</td>
<td>$z_2$ .098</td>
<td>-.074</td>
<td>.005476</td>
<td>26.4615</td>
<td>.144903</td>
</tr>
<tr>
<td>49</td>
<td>.142</td>
<td>.189</td>
<td>-.311</td>
<td>$z_3$ .270</td>
<td>-.172</td>
<td>.029584</td>
<td>7.0204</td>
<td>.207692</td>
</tr>
<tr>
<td>84</td>
<td>.244</td>
<td>.433</td>
<td>-.067</td>
<td>$z_4$ .393</td>
<td>-.123</td>
<td>.015129</td>
<td>4.0952</td>
<td>.061956</td>
</tr>
<tr>
<td>106</td>
<td>.308</td>
<td>.741</td>
<td>-.241</td>
<td>$z_5$ .323</td>
<td>.070</td>
<td>.004900</td>
<td>3.2453</td>
<td>.015902</td>
</tr>
<tr>
<td>57</td>
<td>.166</td>
<td>.907</td>
<td>.407</td>
<td>$z_6$ .166</td>
<td>.157</td>
<td>.024649</td>
<td>6.0351</td>
<td>.148759</td>
</tr>
<tr>
<td>27</td>
<td>.078</td>
<td>.985</td>
<td>.485</td>
<td>$z_7$ .037</td>
<td>.129</td>
<td>.016641</td>
<td>12.7407</td>
<td>.212018</td>
</tr>
<tr>
<td>5</td>
<td>.015</td>
<td>1.000</td>
<td>.500</td>
<td>$z_8$ .000</td>
<td>.037</td>
<td>.001369</td>
<td>68.8000</td>
<td>.094187</td>
</tr>
</tbody>
</table>

$\frac{1}{2}a$ = Cumulative frequency - .500.

**These ordinates were computed by means of Table 43 in Holzinger's Statistical Methods for Students in Education, p. 212.

$\frac{N}{f_x}\left(\frac{z_s-z_{s+1}}{N}\right)^2$ = .975
### TABLE V

**CALCULATIONS FOR CORRECTION \( r_{yc} \)**

<table>
<thead>
<tr>
<th>Group Frequency</th>
<th>Area ( \frac{f_x}{N} )</th>
<th>Cumulative Area</th>
<th>( \frac{1}{2} \alpha * )</th>
<th>Ordinates**</th>
<th>( z_s - z_{s+1} )</th>
<th>( \frac{(z_s - z_{s+1})^2}{f_x} )</th>
<th>( \frac{N}{f_x} )</th>
<th>( \frac{N}{f_x} \left( \frac{(z_s - z_{s+1})^2}{f_x} \right) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>.235</td>
<td>.235</td>
<td>-.265</td>
<td>( z_1 ) .307</td>
<td>-.307</td>
<td>.094249</td>
<td>4.2469</td>
<td>.400266</td>
</tr>
<tr>
<td>93</td>
<td>.270</td>
<td>.505</td>
<td>.005</td>
<td>( z_2 ) .399</td>
<td>-.092</td>
<td>.008464</td>
<td>3.6989</td>
<td>.031307</td>
</tr>
<tr>
<td>93</td>
<td>.270</td>
<td>.775</td>
<td>.275</td>
<td>( z_3 ) .500</td>
<td>.099</td>
<td>.009801</td>
<td>3.6989</td>
<td>.036253</td>
</tr>
<tr>
<td>77</td>
<td>.224</td>
<td>.999</td>
<td>.500</td>
<td>( z_4 ) .000</td>
<td>.300</td>
<td>.090000</td>
<td>4.4675</td>
<td>.402075</td>
</tr>
<tr>
<td>344</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>r_{yc} = \sqrt{.869901} = .933</td>
<td></td>
</tr>
</tbody>
</table>

*\( \frac{1}{2} \alpha * \) = Cumulative frequency - .500.

**These ordinates were computed by means of Table 43 in Holzinger's *Statistical Methods for Students in Education*, p. 212.
B. Contingency Tables

### TABLE VI

**ALGEBRA MARKS AND I. Q.'S FOR ALL PUPILS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Below 75</th>
<th>75-84.9</th>
<th>85-94.9</th>
<th>95-104.9</th>
<th>105-114.9</th>
<th>115-124.9</th>
<th>Above 125</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8</td>
<td>26</td>
<td>74</td>
<td>98</td>
<td>90</td>
<td>36</td>
<td>12</td>
<td>344</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>19</td>
<td>35</td>
<td>20</td>
<td>12</td>
<td>4</td>
<td></td>
<td>93</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>10</td>
<td>26</td>
<td>24</td>
<td>25</td>
<td>3</td>
<td>2</td>
<td>93</td>
</tr>
<tr>
<td>D</td>
<td>5</td>
<td>12</td>
<td>23</td>
<td>20</td>
<td>15</td>
<td>2</td>
<td></td>
<td>77</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}} \quad r_{xc} = .973
\]

\[
S = 1.220072 \quad r_{yc} = .933
\]

\[
S - 1 = .220072 \quad \sigma^2 = .220072
\]

\[
c = .429 \quad \frac{c - l \pm .6745 \sqrt{2c}}{\sqrt{N}} = .078 \pm .015
\]

Therefore \( C \) is significant.
### TABLE VII
**ALGEBRA MARKS AND I. Q.'S FOR BOYS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Below 75</th>
<th>75-84.9</th>
<th>85-94.9</th>
<th>95-104.9</th>
<th>105-114.9</th>
<th>115-124.9</th>
<th>125-Above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>8</td>
<td>14</td>
<td>12</td>
<td>3</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>9</td>
<td>16</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>7</td>
<td>19</td>
<td>14</td>
<td>2</td>
<td>3</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>11</td>
<td>16</td>
<td>14</td>
<td>2</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6</td>
<td>22</td>
<td>44</td>
<td>52</td>
<td>22</td>
<td>6</td>
<td>210</td>
<td></td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \]
\[ r_{xc} = .972 \]
\[ r_{yc} = .929 \]
\[ S = 1.249382 \]
\[ S - 1 = .249382 \]
\[ C = .447 \]
\[ \phi^2 = .249382 \]
\[ c^C = \frac{C}{r_{xc} \times r_{yc}} \]
\[ c - 1 + \frac{.6745 \sqrt{2c}}{N} = .129 \pm .024 \]

Therefore \( C \) is significant.
### TABLE VIII
ALGEBRA MARKS AND I. Q.'S FOR GIRLS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Below 75</th>
<th>75-84.9</th>
<th>85-94.9</th>
<th>95-104.9</th>
<th>105-114.9</th>
<th>115-124.9</th>
<th>125 Above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td>6</td>
<td>11</td>
<td>16</td>
<td>7</td>
<td>3</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>10</td>
<td>19</td>
<td>8</td>
<td>7</td>
<td>3</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>3</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td></td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td>2</td>
<td>18</td>
<td></td>
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<tr>
<td>Total</td>
<td>2</td>
<td>4</td>
<td>30</td>
<td>46</td>
<td>32</td>
<td>14</td>
<td>6</td>
<td>134</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
r_{xc} = .965
\]

\[
S = 1.320641
\]

\[
r_{yc} = .925
\]

\[
S - 1 = .320641
\]

\[
cC = .553
\]

\[
C = .493
\]

\[
\phi^2 = .320641
\]

\[
c^C = \frac{C}{r_{xc} \times r_{yc}} = \frac{c - 1 + \frac{.6745}{\sqrt{N}}}{N} = .201 \pm .038
\]

Therefore, C is significant.
TABLE IX
ALGEBRA MARKS AND EIGHTH GRADE ARITHMETIC
FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>9</td>
<td>25</td>
<td>47</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>23</td>
<td>38</td>
<td>29</td>
<td>93</td>
</tr>
<tr>
<td>C</td>
<td>14</td>
<td>30</td>
<td>35</td>
<td>14</td>
<td>93</td>
</tr>
<tr>
<td>D</td>
<td>13</td>
<td>40</td>
<td>19</td>
<td>5</td>
<td>77</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>102</td>
<td>117</td>
<td>95</td>
<td>344</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.257502
\]

\[
S - 1 = .257502
\]

\[
C = .453
\]

\[
c^2 = .521
\]

\[
\phi^2 = .257502
\]

\[
c^C = \frac{C}{r_{xc} \cdot r_{yc}} \quad \frac{c - 1 \pm .6745 \sqrt{2c}}{N} = .044 \pm .011
\]

Therefore C is significant.
TABLE X
ALGEBRA MARKS AND EIGHTH GRADE ARITHMETIC
FOR BOYS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>11</td>
<td>23</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>11</td>
<td>20</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>C</td>
<td>11</td>
<td>25</td>
<td>25</td>
<td>6</td>
<td>67</td>
</tr>
<tr>
<td>D</td>
<td>9</td>
<td>31</td>
<td>15</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>71</td>
<td>71</td>
<td>46</td>
<td>210</td>
</tr>
</tbody>
</table>

\[
c = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.304723
\]

\[
S - 1 = .304723
\]

\[
cC = .483
\]

\[
\phi^2 = .304723
\]

\[
cC = \frac{C}{r_{xc} \times r_{yc}} \frac{c - 1 + .6745 \sqrt{2c}}{N} = .071 \pm .013
\]

Therefore C is significant.
### TABLE XI

**ALGEBRA MARKS AND EIGHTH GRADE ARITHMETIC FOR GIRLS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Arithmetic Marks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>31</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.238596
\]

\[
S - 1 = 0.238596
\]

\[
C = 0.439
\]

\[
\varphi^2 = 0.238596
\]

\[
cC = \frac{C}{r_{xc} \times r_{yc}} \quad \frac{c - 1 \pm 0.6745 \sqrt{2c}}{N} = 0.112 \pm 0.028
\]

Therefore \( C \) is significant.
TABLE XII
ALGEBRA MARKS AND EIGHTH GRADE AVERAGE SCHOLARSHIP FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Average Scholarship</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>A</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>29</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>73</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]
\[
r_{xc} = .921
\]
\[
S = 1.248401
\]
\[
r_{yc} = .933
\]
\[
S - 1 = .248401
\]
\[
cC = .519
\]
\[
C = .446
\]
\[
\varphi^2 = .248401
\]
\[
cC = \frac{C}{r_{xc} x r_{yc}} \frac{c - 1 + .6745 \sqrt{2c}}{N} = .044 \pm .011
\]

Therefore C is significant.
### TABLE XIII

**ALGEBRA MARKS AND EIGHTH GRADE AVERAGE SCHOLARSHIP FOR BOYS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Average Scholarship</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>D</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
<td><strong>59</strong></td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.309827
\]

\[
S - 1 = 0.309827
\]

\[
C = 0.486
\]

\[
\phi^2 = 0.309827
\]

\[
C = \frac{C}{\frac{r_{xc} \times r_{yc}}{N} \pm \frac{0.6745 \sqrt{2C}}{N}} = 0.071 \pm 0.018
\]

Therefore, C is significant.
TABLE XIV

ALGEBRA MARKS AND EIGHTH GRADE AVERAGE SCHOLARSHIP FOR GIRLS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Average Scholarship</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>14</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
r_{xc} = .881
\]

\[
r_{yc} = .925
\]

\[
S = 1.199425
\]

\[
S - 1 = .199425
\]

\[
C = .408
\]

\[
\phi^2 = .199425
\]

\[
c^2 = \frac{C}{r_{xc} \times r_{yc}}
\]

\[
c - 1 \pm .06745 \sqrt{\frac{2c}{N}} = .112 \pm .023
\]

Therefore C is significant.
### TABLE XV
ALGEBRA MARKS AND CHRONOLOGICAL AGES FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Below 13</th>
<th>13-13.9</th>
<th>14-14.9</th>
<th>15-15.9</th>
<th>16-16.9</th>
<th>17-17.9</th>
<th>18-Above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>21</td>
<td>43</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>18</td>
<td>48</td>
<td>15</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>93</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>15</td>
<td>42</td>
<td>16</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>93</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>7</td>
<td>25</td>
<td>25</td>
<td>14</td>
<td>4</td>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10</td>
<td>61</td>
<td>158</td>
<td>64</td>
<td>29</td>
<td>12</td>
<td>10</td>
<td>344</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.125843
\]

\[
S - 1 = .125843
\]

\[
C = .334
\]

\[
C = \frac{C}{r_{xc} \times r_{yc}}
\]

\[
c - 1 + \frac{.6745 \sqrt{2c}}{N} = .078 + .015
\]

Therefore C is significant.
### TABLE XVI

**ALGEBRA MARKS AND CHRONOLOGICAL AGES FOR BOYS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Chronological Ages in Years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below 13</td>
<td>13-13.9</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>8</td>
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<tr>
<td>B</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

\[
\begin{align*}
C &= \sqrt{\frac{S - 1}{S}} \\
S &= 1.141540 \\
S - 1 &= .141540 \\
C &= .352 \\
\varphi^2 &= .141540 \\
cC &= \frac{C}{r_{xc} \times r_{yc}} \\
c - 1 &= \frac{.6745 \sqrt{2c}}{N} = .129 \pm .024
\end{align*}

Therefore, C is not significant.
TABLE XVII
ALGEBRA MARKS AND CHRONOLOGICAL AGES
FOR GIRLS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Below 13</th>
<th>13-14.9</th>
<th>14-15.9</th>
<th>15-16.9</th>
<th>16-17.9</th>
<th>17-18.9</th>
<th>Above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>13</td>
<td>20</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>13</td>
<td>23</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td>47</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>7</td>
<td>12</td>
<td>4</td>
<td></td>
<td>1</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td></td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
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<td>60</td>
<td>20</td>
<td>9</td>
<td>2</td>
<td>2</td>
<td>134</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.181774
\]

\[
S - 1 = .181774
\]

\[
C = .392
\]

\[
r_{xc} = .950
\]

\[
r_{yc} = .924
\]

\[
c^C = .446
\]

\[
\varphi^2 = .181774
\]

\[
c^C = \frac{C}{r_{xc} \times r_{yc}} \quad \frac{c - 1 + .6745 \sqrt{2c}}{N} = .201 \pm .038
\]

Therefore \( C \) is not significant.
### TABLE XVIII
ALGEBRA MARKS AND OCCUPATIONS OF PARENTS
FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Profes-</th>
<th>Cler-</th>
<th>Skilled</th>
<th>Sales-</th>
<th>Business</th>
<th>Day</th>
<th>Farmers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sional</td>
<td>ical</td>
<td>Artisans</td>
<td>men,</td>
<td>Execu-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class</td>
<td>Workers</td>
<td></td>
<td>Clerks</td>
<td>itives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>16</td>
<td>5</td>
<td>15</td>
<td>16</td>
<td>8</td>
<td>12</td>
<td>2</td>
<td>74</td>
</tr>
<tr>
<td>B</td>
<td>17</td>
<td>5</td>
<td>18</td>
<td>14</td>
<td>11</td>
<td>17</td>
<td>5</td>
<td>87</td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>1</td>
<td>19</td>
<td>14</td>
<td>13</td>
<td>19</td>
<td>4</td>
<td>83</td>
</tr>
<tr>
<td>D</td>
<td>9</td>
<td>2</td>
<td>19</td>
<td>15</td>
<td>7</td>
<td>20</td>
<td>2</td>
<td>74</td>
</tr>
<tr>
<td>Total</td>
<td>55</td>
<td>13</td>
<td>71</td>
<td>59</td>
<td>39</td>
<td>68</td>
<td>13</td>
<td>318</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.040215
\]

\[
S - 1 = .040215
\]

\[
C = .197
\]

\[
c = \frac{C}{\sqrt{r_{xc} \times r_{yc}}}
\]

\[
r_{xc} = .961
\]

\[
r_{yc} = .931
\]

\[
c^2 = .220
\]

\[
\phi^2 = .040215
\]

\[
c = 1 + 0.6745 \frac{\sqrt{2\phi}}{N} = 0.035 + .016
\]

Therefore, C is significant.
TABLE XIX

ALGEBRA MARKS AND OCCUPATIONS OF PARENTS FOR BOYS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Professional Class</th>
<th>Clerical Workers</th>
<th>Skilled Artisans</th>
<th>Salesmen, Clerks</th>
<th>Business Executives</th>
<th>Day Laborers</th>
<th>Farmers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>37</td>
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</tr>
<tr>
<td>B</td>
<td>8</td>
<td>1</td>
<td>10</td>
<td>7</td>
<td>5</td>
<td>12</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td>C</td>
<td>8</td>
<td>1</td>
<td>13</td>
<td>10</td>
<td>7</td>
<td>16</td>
<td>2</td>
<td>57</td>
</tr>
<tr>
<td>D</td>
<td>7</td>
<td>2</td>
<td>16</td>
<td>14</td>
<td>6</td>
<td>10</td>
<td>1</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>4</td>
<td>45</td>
<td>39</td>
<td>22</td>
<td>45</td>
<td>6</td>
<td>194</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{s}} \quad r_{xc} = .953
\]
\[
S = 1.053578
\]
\[
S - 1 = .053578
\]
\[
C = .226
\]
\[
\phi^2 = .053578
\]
\[
c = \frac{C}{r_{xc} \times r_{yc}} \quad \frac{c - 1 + \sqrt{2c}}{N} = .139 \pm .026
\]

Therefore, \( C \) is significant.
### TABLE XX
ALGEBRA MARKS AND OCCUPATIONS OF PARENTS FOR GIRLS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Professional Class</th>
<th>Clerical Workers</th>
<th>Skilled Artisans</th>
<th>Salesmen, Clerks</th>
<th>Business Executives</th>
<th>Day Laborers</th>
<th>Farmers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6</td>
<td>5</td>
<td>9</td>
<td>8</td>
<td>4</td>
<td>5</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>4</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>22</td>
<td>9</td>
<td>26</td>
<td>20</td>
<td>17</td>
<td>23</td>
<td>7</td>
<td>124</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 1.244739
\]

\[
S - 1 = 0.244739
\]

\[
C = 0.443
\]

\[
C' = \frac{c}{\sqrt{r_{xc} \times r_{yc}}}
\]

\[
r_{xc} = 0.965
\]

\[
r_{yc} = 0.929
\]

\[
\phi^2 = 0.244739
\]

\[
cC = \frac{c - 1 + 0.6745\sqrt{2c}}{N} = 0.218 \pm 0.041
\]

Therefore, \( C \) is not significant.
# TABLE XXI

ALGEBRA MARKS AND PER CENT ABSENCE FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Per Cent Absence</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2.0 4.0 9.0 Above</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>68</td>
<td>7</td>
</tr>
<tr>
<td>B</td>
<td>76</td>
<td>13</td>
</tr>
<tr>
<td>C</td>
<td>71</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>42</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>257</td>
<td>33</td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \]
\[ \phi^2 = \frac{c - 1 + 0.6745 \sqrt{2c}}{N} = 0.044 + 0.011 \]

Therefore \( C \) is significant.
# TABLE XXII

**ALGEBRA MARKS AND PER CENT ABSENCE FOR ALL PUPILS**

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Per Cent Absence</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1-2.0</td>
</tr>
<tr>
<td>A</td>
<td>44</td>
<td>24</td>
</tr>
<tr>
<td>B</td>
<td>43</td>
<td>33</td>
</tr>
<tr>
<td>C</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>D</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>150</td>
<td>107</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}} \\
S = 1.148697 \\
S - 1 = .148697 \\
C = .360 \\
\rho^2 = .148697 \\
C = \frac{C}{r_{xc} \times r_{yc}} \\
\frac{c - 1 \pm .067 \sqrt{2c}}{N} = .067 \pm .014 \\
\]

Therefore C is significant.
### TABLE XXIII
ALGEBRA MARKS AND PER CENT ABSENCE FOR BOYS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Per Cent Absence</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2.0</td>
<td>2.1-4.0</td>
</tr>
<tr>
<td>A</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>B</td>
<td>23</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>86</td>
<td>65</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
r_{xc} = .929
\]

\[
S = 1.145645
\]

\[
r_{yc} = .916
\]

\[
S - 1 = .145645
\]

\[
c^C = .419
\]

\[
C = .357
\]

\[
\varphi^2 = .145645
\]

\[
c^C = \frac{C}{r_{xc} \times r_{yc}}
\]

\[
\frac{c - 1 \pm \frac{.6745 \sqrt{2c}}{N}}{N} = .110 \pm .022
\]

Therefore C is significant.
TABLE XXIV
ALGEBRA MARKS AND PER CENT ABSENCE FOR GIRLS

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>Per Cent Absence</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-2.0</td>
<td>2.1-4.0</td>
</tr>
<tr>
<td>A</td>
<td>26</td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>18</td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>42</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}} \\
S = 1.233435 \\
S - 1 = .233435 \\
C = .435 \\
\beta^2 = .233435 \\
c_C = \frac{C}{r_{xc} \times r_{yc}} \\
c - 1 \pm .6745 \sqrt{\frac{2c}{N}} = .142 \pm .032 \\
\]

Therefore C is significant.
TABLE XXV

ALGEBRA MARKS AND MENTAL AGES FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Mental Ages In Years</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 11</td>
<td>3</td>
</tr>
<tr>
<td>11-11.9</td>
<td>11</td>
</tr>
<tr>
<td>12-12.9</td>
<td>31</td>
</tr>
<tr>
<td>13-13.9</td>
<td>60</td>
</tr>
<tr>
<td>14-14.9</td>
<td>90</td>
</tr>
<tr>
<td>15-15.9</td>
<td>70</td>
</tr>
<tr>
<td>16-16.9</td>
<td>58</td>
</tr>
<tr>
<td>17-17.9 Above</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Algebra Marks</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 11</td>
<td>1</td>
<td>9</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>11-11.9</td>
<td>6</td>
<td>15</td>
<td>5</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>12-12.9</td>
<td>16</td>
<td>31</td>
<td>8</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td>13-13.9</td>
<td>21</td>
<td>19</td>
<td>21</td>
<td>18</td>
<td>60</td>
</tr>
<tr>
<td>14-14.9</td>
<td>25</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>60</td>
</tr>
<tr>
<td>15-15.9</td>
<td>17</td>
<td>4</td>
<td>11</td>
<td>14</td>
<td>31</td>
</tr>
<tr>
<td>16-16.9</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>17-17.9 Above</td>
<td>12</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>21</td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \]
\[ r_{xc} = .981 \]
\[ S = 1.195105 \]
\[ r_{yc} = .933 \]
\[ S - 1 = .195105 \]
\[ C = .404 \]
\[ \phi^2 = .195105 \]
\[ cC = \frac{C}{r_{xc} \times r_{yc}} \]
\[ c - 1 \pm \frac{.6745 \sqrt{2c}}{N} \]
\[ = .090 \pm .016 \]

Therefore C is significant.
### TABLE XXVI

**ALGEBRA MARKS AND MENTAL AGES FOR BOYS**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra Marks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>9</td>
<td>13</td>
<td>7</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>6</td>
<td>16</td>
<td>10</td>
<td>9</td>
<td>1</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>15</td>
<td>16</td>
<td>11</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>D</td>
<td>1</td>
<td>2</td>
<td>11</td>
<td>16</td>
<td>13</td>
<td>9</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>5</td>
<td>22</td>
<td>38</td>
<td>52</td>
<td>39</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>210</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \quad r_{xc} = 0.976 \]
\[ S = 1.216105 \quad r_{yc} = 0.929 \]
\[ S - 1 = 0.216105 \quad c_C = 0.465 \]
\[ c_C = \frac{C}{r_{xc} \times r_{yc}} \quad \frac{c - 1}{\sqrt{\frac{2}{N}}} = 0.148 \pm 0.026 \]

Therefore, C is significant.
### TABLE XXVII

**ALGEBRA MARKS AND MENTAL AGES FOR GIRLS**

<table>
<thead>
<tr>
<th>Mental Ages in Years</th>
<th>11-11.9</th>
<th>12-12.9</th>
<th>13-13.9</th>
<th>14-14.9</th>
<th>15-15.9</th>
<th>16-16.9</th>
<th>17-Above</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>9</td>
<td>12</td>
<td>12</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>9</td>
<td>15</td>
<td>9</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>10</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6</td>
<td>9</td>
<td>22</td>
<td>38</td>
<td>31</td>
<td>20</td>
<td>8</td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \]

\[ S = 1.299129 \]

\[ S - 1 = .299129 \]

\[ C = .480 \]

\[ c^2 = \frac{C}{r_{xc} \times r_{yc}} \]

\[ c = l \pm \frac{.6745 \sqrt{2c}}{N} = .201 \pm .038 \]

Therefore C is significant.
TABLE XXVIII
MENTAL AGES AND I. Q.'S FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Mental Ages in Years</th>
<th>I. Q.'s</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below 80</td>
<td>80-89.9</td>
</tr>
<tr>
<td>Below 12</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>12-12.9</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>13-13.9</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>14-14.9</td>
<td>7</td>
<td>32</td>
</tr>
<tr>
<td>15-15.9</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>16-16.9</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>17-17.9</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>49</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{\frac{S - 1}{S}}
\]

\[
S = 2.629836
\]

\[
S - 1 = 1.629836
\]

\[
C = .787
\]

\[
\phi^2 = 1.629836
\]

\[
c^2 = \frac{C}{r_{xc} \times r_{yc}}
\]

\[
c = \frac{C}{\sqrt{\frac{r_{xc}}{N} \times \frac{r_{yc}}{N}}}
\]

\[
c - 1 + \frac{.6745 \sqrt{2c}}{N} = .119 + .018
\]

Therefore \( C \) is significant.
TABLE XXIX
MENTAL AGES AND I. Q.'S FOR ALL PUPILS

<table>
<thead>
<tr>
<th>Mental Ages in Years</th>
<th>I. Q.'s</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Below 70</td>
<td>70-79.9</td>
</tr>
<tr>
<td>Below 11</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11-11.9</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>12-12.9</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>13-13.9</td>
<td>21</td>
<td>30</td>
</tr>
<tr>
<td>14-14.9</td>
<td>7</td>
<td>32</td>
</tr>
<tr>
<td>15-15.9</td>
<td>14</td>
<td>32</td>
</tr>
<tr>
<td>16-16.9</td>
<td>17</td>
<td>30</td>
</tr>
<tr>
<td>17 Above</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

\[ C = \sqrt{\frac{S - 1}{S}} \]
\[ r_{xc} = 0.975 \]
\[ r_{yc} = 0.981 \]
\[ S = 3.567159 \]
\[ c = 0.848 \]
\[ \sigma^2 = 2.567159 \]

Therefore, C is significant.
TABLE XXX
MENTAL AGES AND I.Q.'S FOR BOYS

<table>
<thead>
<tr>
<th>Mental Ages in Years</th>
<th>Below 70</th>
<th>70-79.9</th>
<th>80-89.9</th>
<th>90-99.9</th>
<th>100-109.9</th>
<th>110-119.9</th>
<th>120-129.9</th>
<th>130-139.9</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 11</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>11-11.9</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>12-12.9</td>
<td>7</td>
<td>11</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>22</td>
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<tr>
<td>13-13.9</td>
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<td>14</td>
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<td>38</td>
</tr>
<tr>
<td>14-14.9</td>
<td>7</td>
<td>17</td>
<td>25</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>52</td>
</tr>
<tr>
<td>15-15.9</td>
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<td>18</td>
<td>13</td>
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<td></td>
<td></td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>16-16.9</td>
<td></td>
<td>10</td>
<td>24</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>38</td>
</tr>
<tr>
<td>17- Above</td>
<td></td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>13</td>
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<tr>
<td>Total</td>
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<td>43</td>
<td>59</td>
<td>41</td>
<td>13</td>
<td>2</td>
<td>210</td>
</tr>
</tbody>
</table>

\[
C = \sqrt{S - l}
\]

\[
S = 3.234546
\]

\[
S - l = 2.234546
\]

\[
C = 0.831
\]

\[
c^2 = \frac{C}{r_{xc} \times r_{yc}}
\]

\[
r_{xc} = 0.967
\]

\[
r_{yc} = 0.976
\]

\[
c^2 = 2.234546
\]

\[
c - l + 0.6745 \sqrt{2c} = 0.300 \pm 0.036
\]

Therefore \( C \) is significant.
TABLE XXXI
MENTAL AGES AND I. Q.'S FOR GIRLS

<table>
<thead>
<tr>
<th>Mental Ages in Years</th>
<th>I. Q.'s</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70- 79.9</td>
<td>80- 89.9</td>
<td>90- 99.9</td>
<td>100- 109.9</td>
<td>110- 119.9</td>
<td>120- 129.9</td>
</tr>
<tr>
<td>11- 11.9</td>
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<td>13- 13.9</td>
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<td>14- 14.9</td>
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<td>15- 15.9</td>
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<tr>
<td>16- 16.9</td>
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<td>11</td>
<td>41</td>
<td>47</td>
<td>16</td>
<td>14</td>
</tr>
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</table>

\[
C = \sqrt{\frac{S - 1}{S}} \quad \quad \quad r_{xc} = 0.963
\]
\[
S = 2.880019
\]
\[
S - 1 = 1.880019
\]
\[
c = 0.808
\]
\[
c = \frac{\frac{c}{e}}{r_{xc} \times r_{yc}} \quad \quad \quad \phi^2 = 1.880019
\]
\[
c = 0.861
\]
\[
N = \frac{c - 1 + \frac{\sqrt{2c}}{c}}{N} = 0.358 \pm 0.050
\]

Therefore C is significant.
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