A Study of the Relation of the South Dakota High-School Scholastic Contest Scores and Marks in a South Dakota High School

Bernard Dahlen

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A STUDY OF THE RELATION OF THE SOUTH DAKOTA HIGH-SCHOOL
SCHOLASTIC CONTEST SCORES AND MARKS IN A
SOUTH DAKOTA HIGH SCHOOL

By
Bernard Dahlen

A problem submitted to the Faculty of the South Dakota
State College of Agriculture and Mechanic Arts in
partial fulfillment of the requirements for
the degree of Master of Science (Plan B)
July 26, 1950
ACKNOWLEDGMENT

I am grateful to Dr. C. R. Wiseman, Head of the Education Department of South Dakota State College, for his guidance and helpful suggestions in the writing of this paper, and to Dr. William H. Batson, Director of the School of Education at the University of South Dakota, for sending me testing materials and information on previous research studies made in connection with the South Dakota Scholastic Contest.
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</tr>
</tbody>
</table>
INTRODUCTION

The question of the validity of marks given in high school as indicators of the scholastic ability of the students has often been discussed. Are marks true indicators of the knowledge that the student possesses when he graduates from high school? Are the teachers marking too high? How does the marking system compare as to the value of the marks given and the knowledge possessed? These and similar questions have led the writer to pursue this study in a small way.

Studies have previously been made to show the correspondence between scores made on the South Dakota Scholastic Contest and marks attained in college. Data have also been tabulated showing the relatively high marks made in college by the ten top-ranking seniors each year during a ten-year period, but no work is known by the author where the results of the test are compared to the marks previously earned in high school.

By making the comparisons enumerated in the statement of the problem, this study seeks to show the relationship that exists between the Preliminary Scholastic Test scores and high-school marks.

1. Ben Burris, A Study of the Relation of the South Dakota High School Scholastic Contest Scores and College Grades, State University, Vermillion, S. D., 1947
THE PURPOSE OF THE STUDY

The purpose of the study is to make a comparison between the achievements of the seniors of Hartford High School, Hartford, South Dakota, and the average achievement of the seniors of South Dakota by use of the Preliminary High-School Scholastic Contest as distributed by the University of South Dakota under the direction of Dr. Wm. H. Batson. The particular questions raised in this problem are:

1. What relationship exists between the marks received by individual high-school seniors in the Preliminary High-School Contest for the years 1948 and 1949 and their high-school mean marks in each of the four subject fields?

2. What relationship exists between the average scores received by these same high-school seniors on the Preliminary High-School Scholastic Contest and their mean marks in all four subject fields during their four years in high school?

3. Can the scores received by high-school seniors in the Preliminary High-School Scholastic Contest be used to evaluate the efficiency of the department and the reliability of the marking system used?
THE PRELIMINARY SCHOLASTIC CONTEST

In order to understand the comparisons made it is necessary to say a few words about the High-School Scholastic Contest program as it relates to this problem. Throughout the problem the Preliminary High-School Contest will be referred to by the short title of Preliminary Contest and the word, score, will refer to the number of correct answers made on the Preliminary Contest.

In the High-School Scholastic Contest program two separate tests are given each year and are referred to as the preliminary and the final examinations. The Preliminary Examinations are given each spring to all high-school seniors wishing to take them. They cover the four basic fields of English, history, science, and mathematics. In the English part of the test there are sixty-five questions, and on each of the other parts there are fifty questions. As soon as the tests have been given, the answers are returned to the State University for scoring. The results giving scores made by each student in each of the four basic fields and the average of all four fields together with the corresponding averages for all seniors who took the test are returned to the high school.

In comparing scores it is well to keep in mind that scores are based on schools whose whole senior class or nearly the whole senior class took the examination. Schools in which only a part of the seniors took the examination should rank
higher. For instance, if only the upper half of the seniors participated, then the average for that school should rank in the upper quarter.

In reporting the results of the Preliminary Tests to the schools Dr. Batson used the word "average" in referring to what is evidently the mean score. In order to identify this for the reader, wherever this is quoted or referred to in the following pages, quotation marks are placed around the word "average". Copies of the Preliminary Examination and the report may be found in the Appendices.

For more complete information concerning the High-School Scholastic Contest Program in South Dakota, reference is made to the publication "High School Scholastic Contest in South Dakota".¹

¹ William H. Batson, High School Scholastic Contest in South Dakota, University of South Dakota, Vermillion, South Dakota, 1946.
THE HARTFORD HIGH-SCHOOL MARKING SYSTEM

The mean marks of the Hartford High-School seniors for the years 1948 and 1949 were taken from the permanent records in the superintendent's office, where they were recorded in the letters, A, A-, B\textsuperscript{1}, B, B-, C\textsuperscript{1}, C, C-, D\textsuperscript{1}, D, D-, and F. For convenience in securing the mean, A was assigned the number twelve, A- eleven, and so on down to F which was assigned the number one. The letter C is considered to be the mark which a normal student would receive when the sampling was large enough and the marking system functioning correctly. The following chart shows the marks, their assigned value, and the corresponding percentages.

Chart of the Hartford High-School Marking System

<table>
<thead>
<tr>
<th>Marks in letters</th>
<th>Assigned point values</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12</td>
<td>96 - 100</td>
</tr>
<tr>
<td>A-</td>
<td>11</td>
<td>93 - 95</td>
</tr>
<tr>
<td>B\textsuperscript{1}</td>
<td>10</td>
<td>91 - 92</td>
</tr>
<tr>
<td>B</td>
<td>9</td>
<td>89 - 90</td>
</tr>
<tr>
<td>B-</td>
<td>8</td>
<td>87 - 88</td>
</tr>
<tr>
<td>C\textsuperscript{1}</td>
<td>7</td>
<td>85 - 86</td>
</tr>
<tr>
<td>C</td>
<td>6</td>
<td>83 - 84</td>
</tr>
<tr>
<td>C-</td>
<td>5</td>
<td>81 - 82</td>
</tr>
<tr>
<td>D\textsuperscript{1}</td>
<td>4</td>
<td>79 - 80</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>77 - 78</td>
</tr>
<tr>
<td>D-</td>
<td>2</td>
<td>75 - 76</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
SECURING THE DATA

The data for this problem were secured by giving the Preliminary Scholastic Test to the seniors of Hartford High School shortly before graduation in April of 1948 and 1949. Fourteen seniors took the tests in 1948 and eleven in 1949. One member of the 1949 class was not included in this problem as he was a returned veteran whose years of experience in the Army was thought to make his case an exceptional one, thus leaving twenty-four cases.

The average or mean marks of these twenty-four seniors were secured from the permanent records of the Hartford High School. These data, the marks in the high-school subjects and the scores made by the students in the Preliminary Tests, were arranged in tables -- one table for each of the four subject fields of English, history, science, and mathematics, and one table for the "averages" of all four fields. Each table contained five columns, one for each of the following divisions: case number, number of units taken, mean high-school marks, correction factor, and the contest scores. The Hartford High-School seniors are listed by case numbers one to twenty-four. The seniors of the class of 1948 are case numbers one through fourteen, and the class of 1949 are case numbers fifteen through twenty-four. The units taken in each of the fields and the mean mark received in the field under consideration during the four years in high school are listed. The Preliminary Test scores are arranged in descending order.
with the "average" for the state labeled.

The "averages", as given in the Report on the Preliminary Scholastic Contest, are evidently the arithmetic means and are to be considered as such when used in connection with the Preliminary Contest. It should also be noted that the quartiles are given a meaning contrary to their accepted usage; first, in reversing their order, and second, in giving them a name which is usually called quarters. The "averages" as given in the report are listed at the bottom of each table for use in comparison with the high-school mean. The numbers and the terminology were copied as they were found in the report of the results of the Preliminary Scholastic Tests.

Since the "averages" on the Preliminary Tests for 1948 and 1949 were different, the scores for 1949 were weighted so that they could be compared to the state "average" for 1948. This weighting was accomplished by adding or subtracting, as the case required, the difference of the state "average" for the two years in the part of the test under consideration. This difference is shown in the table as the correction factor. This method was thought to be quite satisfactory since most of the scores of the seniors of Hartford High School were grouped around the state "average", with no extremely high or low scores.

Ordinarily data of this type would lend themselves to computations of correlations between the two sets of essential data: the pupils' subject marks in the selected areas, and the pupils' achievement scores in the Preliminary Contest.
However, with such a small number of cases it was thought sufficient and much simpler here to use a simple graphic technique reported by both Arkin and Colton\(^1\) and by Symonds\(^2\), where a simple scatter diagram was made. Thus the reader will find a scatter diagram immediately following each table presenting in graphic form the essential data. As will be explained later in connection with the tables and scatter diagrams, some idea of the degree of relationship (correlation) between the two separate measures can be seen.

The scatter diagrams were constructed as follows: the two associated series are plotted graphically with the high-school marks on the X axis and the "average" Preliminary Contest scores on the Y axis. If there is a considerable relationship resulting from plotting the associated variables on a chart, the points spotted will follow a definite line of movement or "path" hovering around a line running diagonally from lower left to upper right of the diagram. When the series are imperfectly associated, the more or less imperfect relationship will cause points to depart from the indicated line creating a scatter.\(^3\)

The vertical line representing the mean high-school mark and the horizontal line representing the "average"

\(^1\) Herbert Arkin and Raymond R. Colton, *An Outline of Statistical Method*, pp. 75.


\(^3\) Herbert Arkin and Raymond R. Colton, *loc. cit.*
Preliminary Test scores intersect dividing the diagram into four quadrants. One can learn considerable about the individual student and about the class as a whole by noting into which quadrant the points fall. If the points are in the upper right quadrant, they indicate students who are above the mean in both marks and scores. Represented in the lower left section are students whose marks and scores are both below the mean for the class and the "average" for the state respectively. The points in the upper left corner indicate students who are below the mean in their marks but above the "average" in their scores, while those in the lower right quadrant represent students who are above the mean in their marks and below the "average" in their scores.
Findings in the Field of English

Mention has been made that two series of essential data were found for these students in four subject areas: English, history, science, and mathematics. This section sets forth the data presented for the field of English, and sections for each of the other subject areas and for a composite of all the four areas follow.

First is presented the table and the scatter diagram for the English marks and scores, Table I, page 9 and Fig. 1, page 10.

Table I is made up of the following five columns: the case or student number, the number of units of English taken, the mean high-school mark, the correction factor as between the 1948 and the 1949 Preliminary Contest scores, and the corrected score. The Preliminary Contest scores are arranged in a descending order with the scores for the class of 1949 reduced ten points so as to bring them in line with the scores for 1948 as explained on page 7.

A comparison of the Hartford High-School mean mark with the state "average" can be made by noting the number of cases above and below the score marked for the state "average" and also by noting the difference between the high-school mean given at the bottom of Table I and the state "average". The mean school mark in English for these twenty-four seniors was B-. On the Preliminary Contest these seniors had a mean
<table>
<thead>
<tr>
<th>CASE NO.</th>
<th>UNITS</th>
<th>SCHOOL MARK</th>
<th>CORRECTION FACTOR</th>
<th>CONTEST SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>17.</td>
<td>4</td>
<td>A-</td>
<td>-10</td>
<td>42</td>
</tr>
<tr>
<td>14.</td>
<td>4</td>
<td>A</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>5.</td>
<td>4</td>
<td>A</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>6.</td>
<td>4</td>
<td>A</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>3.</td>
<td>4</td>
<td>C-</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>19.</td>
<td>4</td>
<td>A</td>
<td>-10</td>
<td>37</td>
</tr>
<tr>
<td>24.</td>
<td>4</td>
<td>B</td>
<td>-10</td>
<td>37</td>
</tr>
<tr>
<td>16.</td>
<td>4</td>
<td>B</td>
<td>-10</td>
<td>35</td>
</tr>
<tr>
<td>22.</td>
<td>4</td>
<td>B-</td>
<td>-10</td>
<td>35</td>
</tr>
<tr>
<td>15.</td>
<td>4</td>
<td>C</td>
<td>-10</td>
<td>35</td>
</tr>
<tr>
<td>18.</td>
<td>4</td>
<td>C-</td>
<td>-10</td>
<td>33</td>
</tr>
<tr>
<td>21.</td>
<td>4</td>
<td>B</td>
<td>-10</td>
<td>33</td>
</tr>
<tr>
<td>2.</td>
<td>4</td>
<td>B</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>23.</td>
<td>4</td>
<td>D-</td>
<td>-10</td>
<td>27</td>
</tr>
<tr>
<td>10.</td>
<td>4</td>
<td>B</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>13.</td>
<td>4</td>
<td>B-</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>1.</td>
<td>4</td>
<td>B</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>20.</td>
<td>4</td>
<td>C-</td>
<td>-10</td>
<td>21</td>
</tr>
<tr>
<td>7.</td>
<td>4</td>
<td>C</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>8.</td>
<td>4</td>
<td>D-</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>12.</td>
<td>4</td>
<td>D-</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>11.</td>
<td>4</td>
<td>C</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>9.</td>
<td>4</td>
<td>C-</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>4.</td>
<td>4</td>
<td>D</td>
<td></td>
<td>8</td>
</tr>
</tbody>
</table>

**Mean**  
B-  
31.8

Average Score of 4460 high-school seniors who took the Preliminary Scholastic Test in English for 1948........... 28*
Fig. 1, SCATTER DIAGRAM OF PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST SCORES AND MEAN HIGH-SCHOOL MARKS ACHIEVED IN THE FIELD OF ENGLISH AS IN TABLE I

Average score of 4460 high-school seniors who took the Preliminary Scholastic Test in English for 1948 . . . . 28*
test score of 31.8. Note that the "average" of the 4460 South Dakota high-school students who took the test in 1948 was 28 giving the Hartford seniors nearly four points advantage. The essential data in Table I were then set up in the scatter diagram as shown in Fig. 1. Notice that the figure is divided into four quadrants by the line representing mean subject marks and by the line representing the "average" contest scores.

In the scatter diagram, Figure 1, for English the marks are spotted on the X axis, and the Preliminary Contest scores are plotted on the Y axis. If the correlation were perfect, all points would lie along the imaginary diagonal from the lower left corner to the upper right corner, while if the correlation were zero, the points would be scattered throughout the circle.¹ The general pattern of the spotted scores on the scatter diagram is somewhat elliptical and tends to extend from the lower left to the upper right. Note that there are relatively few scores in the upper left and lower right quadrants. From this distribution one can see that there is a definite positive correlation.

Conclusions in the Field of English

A study of Table I, together with the corresponding scatter diagram, shows the following conclusions:

1. A positive correlation between the mean marks received in four units of English and the scores made on the Preliminary Scholastic Contest in the field of English existed.

2. Students in Hartford High School compared favorably with other students of the state in their scholastic achievement as shown on the test scores.

3. The English department of Hartford High School was doing superior work according to the scores obtained on the Preliminary Test.

4. The marking system in the school studied appeared to be satisfactory in a comparison of the mean marks and "average" scores.
The second subject area, that of History, was treated and considered in a similar manner to that of English. The scores for the seniors of 1949 were corrected, as explained on page 4, by raising their scores two points—the difference of the "average" scores for the two years. The class of 1948 had a unit of American History in their senior year, while the class of 1949 took their American History in their junior year. The reader will note from the table that the mean contest score of the twenty-four seniors and the "average" score of the 4460 South Dakota seniors was very close -- 34.7 and 35 respectively.

In examining the scatter diagram for the twenty-four seniors, one notes that while there is some tendency for scores to arrange themselves along a diagonal line from the lower left to the upper right quadrant this is not so pronounced as was the case for English in Figure 1. In the History diagram there are relatively more scores in the upper left and lower right quadrants than there are in the English diagram. The correlation between the high-school marks and the contest scores in the field of history is lower than is the correlation in the field of English.
TABLE II. PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST
SCORES AND MEAN HIGH-SCHOOL MARKS RECEIVED
IN THE FIELD OF HISTORY

<table>
<thead>
<tr>
<th>CASE NO.</th>
<th>UNITS</th>
<th>SCHOOL MARK</th>
<th>CORRECTION FACTOR</th>
<th>CONTEST SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2</td>
<td>C-</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td>10.</td>
<td>2</td>
<td>B-</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>14.</td>
<td>2</td>
<td>A</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td>24.</td>
<td>1</td>
<td>A-</td>
<td>12</td>
<td>41</td>
</tr>
<tr>
<td>2.</td>
<td>2</td>
<td>A-</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>4.</td>
<td>1</td>
<td>D</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>5.</td>
<td>2</td>
<td>A</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>6.</td>
<td>2</td>
<td>A</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>3.</td>
<td>2</td>
<td>C-</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>19.</td>
<td>1</td>
<td>B1</td>
<td>12</td>
<td>37</td>
</tr>
<tr>
<td>7.</td>
<td>2</td>
<td>D-</td>
<td></td>
<td>37</td>
</tr>
<tr>
<td>9.</td>
<td>2</td>
<td>D</td>
<td></td>
<td>36</td>
</tr>
<tr>
<td>17.</td>
<td>1</td>
<td>B</td>
<td>12</td>
<td>35</td>
</tr>
<tr>
<td>13.</td>
<td>2</td>
<td>C</td>
<td></td>
<td>34</td>
</tr>
<tr>
<td>16.</td>
<td>2</td>
<td>C1</td>
<td>12</td>
<td>32</td>
</tr>
<tr>
<td>12.</td>
<td>1</td>
<td>D-</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>11.</td>
<td>2</td>
<td>D</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>8.</td>
<td>2</td>
<td>D</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>22.</td>
<td>2</td>
<td>B</td>
<td>12</td>
<td>28</td>
</tr>
<tr>
<td>15.</td>
<td>2</td>
<td>C-</td>
<td>12</td>
<td>28</td>
</tr>
<tr>
<td>20.</td>
<td>2</td>
<td>D1</td>
<td>12</td>
<td>28</td>
</tr>
<tr>
<td>23.</td>
<td>1</td>
<td>D1</td>
<td>12</td>
<td>28</td>
</tr>
<tr>
<td>18.</td>
<td>2</td>
<td>D</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>21.</td>
<td>2</td>
<td>B</td>
<td>12</td>
<td>23</td>
</tr>
</tbody>
</table>

Mean C1 34.7

Average Score of 4460 high-school seniors who took the Preliminary Scholastic Test in History for 1948.......... 35*
Fig. 2. SCATTER DIAGRAM OF PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST SCORES AND MEAN HIGH-SCHOOL MARKS ACHIEVED IN THE FIELD OF HISTORY AS IN TABLE II

Average score of 4460 high-school seniors who took the Preliminary Scholastic Test in History for 1948...35*
Conclusions in the Field of History

A study of Table II and the corresponding scatter diagram, Figure 2, shows the following conclusions:

1. Very little, if any, correlation between the mean marks and the scholastic contest scores existed.

2. The history students of Hartford High School gained as much knowledge as the majority of the seniors in the schools of the state on the material covered by the test.

3. The Hartford teachers have been too lenient in their interpretation of the marking system in view of the test scores.
Findings in the Field of Science

The scores and "average" high-school marks in the field of science are shown in Table III. The scores for the seniors of 1949 were corrected by subtracting the difference of the "averages" of the state scores for the two years which was a -4 points. The units of science taken by the different students range from one to three. The students who have had only one unit of science took it in their freshmen year and so would find the material not so clear in their minds as those who had three units, the third unit having been taken in their junior or senior year. Of the five students who have had three units, none placed among the upper ten cases according to scores, while one student with only one unit placed fourth from the top.

The scatter diagram shows that a majority of the Hartford seniors were below the state "average". The "spots" are widely scattered with a large number of cases in the lower right quadrant. Table III which follows shows the high-school science marks and the contest scores for these twenty-four students. The accompanying scatter diagram is Figure 3.
TABLE III. PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST SCORES AND MEAN HIGH-SCHOOL MARKS RECEIVED IN THE FIELD OF SCIENCE

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<th>CORRECTION FACTOR</th>
<th>CONTEST SCORE</th>
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Mean: C\textsuperscript{1} 21.8

Average Score of 4460 high-school seniors who took the Preliminary Scholastic Test in Science for 1948 ....... 28*
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<th>C</th>
<th>C'</th>
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<th>B</th>
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**Fig. 3. Scatter diagram of Preliminary High-School Scholastic Contest scores and mean high-school marks achieved in the field of Science as in Table III**

Average score of 4460 high-school seniors who took the Preliminary Scholastic Test in Science for 1948 . . . . . 28*
Conclusions in the Field of Science

A study of Table III and the corresponding scatter diagram shows the following conclusions:

1. A low, positive correlation between the mean high-school marks and scores made on the Preliminary Test was shown.

2. The science department of Hartford High School was below the "average" of the majority of the high schools of the state as revealed by the Preliminary Test scores.

3. The Hartford teachers have been too lenient in their interpretation of the marking system in view of the test scores.
Findings in the Field of Mathematics

The mathematics area is the fourth of this series where the data are compared. The data are presented in Table IV and in scatter diagram, Figure 4. Only seven of the twenty-four students had two units of high-school mathematics, and the rest had but one unit. On this account it is rather surprising that the mean contest score for these twenty-four seniors was more than six points higher than the mean of the 4460 students in the state group. Inasmuch as the 1949 state mean for mathematics was the same as the 1948 mean, no correction is shown in Table IV.

The scatter diagram shows in a vivid manner how the Hartford twenty-four seniors were on the average somewhat above the state mean. In this respect their results are comparable to the results revealed in the English diagram. However, there is a greater deviation of scores from the imaginary diagonal in this diagram than in that of English. The general pattern of "spots" approaches a circular arrangement, so the correlation, while positive, is seen to be quite low with a considerable number of cases in the upper left quadrant.
### TABLE IV. PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST SCORES AND MEAN HIGH-SCHOOL MARKS RECEIVED IN THE FIELD OF MATHEMATICS

<table>
<thead>
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<th>UNITS</th>
<th>SCHOOL MARK</th>
<th>CONTEST SCORE</th>
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Mean: B- 26.3

Average Score of 4460 high-school seniors who took the Preliminary Scholastic Test in Mathematics for 1948 ... 20*
Fig. 4, SCATTER DIAGRAM OF PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST SCORES AND MEAN HIGH-SCHOOL MARKS RECEIVED IN THE FIELD OF MATHEMATICS AS IN TABLE IV

Average score of 4460 high-school seniors who took the Preliminary Science Test...
Conclusions in the Field of Mathematics

A study of Table IV and the corresponding scatter diagram shows the following conclusions:

1. A low, positive correlation between the scores made on the Preliminary Contest by the Hartford seniors and the mean marks received in the field of mathematics existed.

2. The mathematics department in Hartford High School appeared to have done superior work in view of the test results.

3. In view of the test results one may conclude that the Hartford marking system was functioning quite satisfactorily.

4. Students who have had two units of mathematics did better on the Preliminary Contest than those with only one unit.
Findings as Shown in a Composite Made of the Four Basic Fields of English, History, Science, and Mathematics

The four immediately preceding sections have presented the findings separately for English, history, science, and mathematics. In this section the marks for these twenty-four Hartford seniors have been composited and compared with the total contest score made by these same seniors. The scores are arranged in a descending order from the highest which is 194 to the lowest which is 81. Under the school-marks column are listed the mean marks received by each student in all four fields during his four years of high school. The contest scores for the seniors of 1949 are corrected by a -12 points, which is the sum of the corrections made in each of the four basic fields. The reader will note from the table that the mean score of the twenty-four seniors and the "average" score of the South Dakota seniors taking the test was very close.

Observations of the scatter diagram, Figure 5 show that averages tend to wipe out variations. The reader will recall that in the data presented in the tables and figures, one to four, each individual student's mean mark and "average" score was spotted. In this section the marks and scores are averaged for each student over four areas. Such averaging tends to cancel out apparent student variations. The net result is that the pattern of "spots" for individual students in Figure 5 is somewhat less erratic than in any of the other four scatter diagrams. In fact the general array seems to form
### TABLE V. PRELIMINARY HIGH-SCHOOL SCHOLASTIC CONTEST

**AVERAGE SCORES AND MEAN HIGH-SCHOOL MARKS**

**IN THE FOUR FIELDS OF ENGLISH, HISTORY, SCIENCE, AND MATHEMATICS**

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<th>CONTEST SCORE</th>
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**Mean**

| C¹ | 111.2 |

Average Score of 4460 high-school seniors who took the Preliminary Scholastic Test in English, History, Science, and Mathematics for 1948 ....................... 112*

First Quartile Range ......................... 129 - 215
Second Quartile Range ........................ 112 - 128
Third Quartile Range ......................... 94 - 111
Fourth Quartile Range ....................... 21 - 93*
Fig. 5, Scatter Diagram of Preliminary High-School Scholastic Contest Average Scores and Mean High-School Marks in the Four Fields of English, History, Science, and Mathematics

Average score of 4460 high-school seniors who took the Preliminary Scholastic Test in English, history, science, and mathematics for 1948

First Quartile Range: 129 - 215
Second Quartile Range: 112 - 128
Third Quartile Range: 94 - 111
Fourth Quartile Range: 21 - 93
a fairly narrow ellipse starting from the lower left quadrant to the upper right quadrant of the diagram with no cases in the upper left quadrant and few in the lower right quadrant.

Conclusions in a Composite of the Four Basic Fields

From a study of the composite of the four basic fields the following conclusions are drawn:

1. Higher positive correlation than any of the four subject fields was shown.

2. Hartford High School ranked slightly below the other high schools of the state on the material covered in the Preliminary Test.

3. Hartford High-School teachers have been too lenient in their interpretation of the marking system.
SUMMARY OF THE STUDY AND SUMMARY OF THE CONCLUSIONS

The title, A Study of the Relation of the South Dakota High-School Scholastic Contest Scores and Marks in a South Dakota High School, reveals the general purpose of this study. The three sub-problems, as set up on page 2, were as follows:

1. What relationship exists between the scores of individual high-school seniors in the Preliminary High-School Scholastic Contest for the years 1948 and 1949 and their high-school mean marks in each of the four subject fields?

2. What relationship exists between the "average" scores of these same high-school seniors on the Preliminary Tests and their mean marks in all four subject fields during their four years in high school?

3. Can the scores of high-school seniors in the Preliminary Test be used to evaluate the efficiency of the department and the reliability of the marking system used?

The essential data were of two types, the school records of the marks received in the school subjects by the twenty-four seniors in Hartford High School, and the Preliminary test results of the seniors of South Dakota. The four basic areas in the contest were English, history, science, and mathematics, and correspondingly the high-school
marks of these twenty-four students for these same four areas were considered. These data were arranged in tables, one for each of the four areas and one for a composite of the four areas. Comparisons of the marks and scores were shown by means of accompanying scatter diagrams.

The tables and scatter diagrams revealed varying degrees of positive correlation between the high-school marks and the test scores. Since some degree of correlation was shown in all fields, it may be said that, on the average, the students who receive the highest marks in high school will do the best on a scholastic achievement test. However, the results showed many differences in individuals thus making predictions of individual cases unreliable.

Further study showed that the students of Hartford High School compared favorably with other students of the state in the fields of English and mathematics and were below the "average" in the fields of history and science. This gave some indication of the efficiency of each of these departments and showed where some action should be taken to strengthen the teaching or assign the marks more satisfactorily.

An attempt was made to determine the efficiency of the Hartford marking system by comparing the mean marks in each of the areas with the "average" scores of all the seniors taking the test. The results were not very satisfactory but did tend to show that the teachers were interpreting the marking system too leniently in the field of science.
In the composite of all four fields, a higher correlation was shown than in any one field, thus making predictions on the composite more reliable than that on any single field. From this section one could secure the most accurate idea of the teaching of the school as a whole.

A study of individual cases showed that in the field of mathematics those with more than one unit receive the highest test scores, while in the fields of history and science those taking one or more units have done little, if any, better than those taking one unit. This suggests that in these fields the students learned a large percent of the material in other classes or outside of school as the expected increase in test scores for added units taken in the respective fields was not evident in the scores made. It might be added that results would increase in reliability with the increase in the number of cases used. Thus high schools with larger senior classes very likely would secure more satisfactory results.

In a summarizing statement, it might be said that a definite relationship does exist between scores on the High School Scholastic Contest examinations and high-school marks, but that relationship is confined to a large division of the test groups and cannot be applied with any degree of accuracy to individual cases.

This study has been an attempt to analyze the results of
the Preliminary Testing Program as it applied to one high school, and it is hoped that the pattern used may be of some help to other administrators who are using similar testing programs.
Summary of Conclusions

1. Varying degrees of positive correlation were evident in the field of English, where the students compared favorably with the other seniors of the state. In this field the teachers seemed to be interpreting the marking system satisfactorily.

2. The results of the history unit showed very little, if any, correlation between the mean marks and the Preliminary Contest scores. The Hartford High-School teachers appeared to have been too lenient in interpreting the marking system, as the marks received by the Hartford seniors were above the mean while their test scores were below the "average".

3. In the unit on science the Hartford seniors were below the "average" of all the seniors taking the test, which indicates that the material was not covered satisfactorily.

4. The results in the field of mathematics showed some positive correlation with the Hartford seniors well above the "average" of all who took the test. It was noticeable that students who have had two units of mathematics did better on the Preliminary Contest than those with only one unit.
5. The composite of the four fields showed greater correlation than any of the separate fields, with the mean score of the Hartford High-School seniors slightly below the state "average". A tendency of the teachers to be too lenient in their interpretation of the marking system was apparent.


APPENDICES
A Copy of a Part of The
REPORT OF THE PRELIMINARY SCHOLASTIC CONTEST

Wm. H. Batson
University of South Dakota
1948

Number of examinations sent out . . . . . . . . 5017
Number of examinations returned and graded . . . . 4460
Number of schools receiving tests . . . . . . . . 212
Number of schools returning tests to be graded . . . 209

Highest score: 204  Lowest score: 21

Averages for all schools:

<table>
<thead>
<tr>
<th></th>
<th>English</th>
<th>History</th>
<th>Science</th>
<th>Mathematics</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible</td>
<td>65</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>215</td>
</tr>
<tr>
<td>Average</td>
<td>28</td>
<td>35</td>
<td>28</td>
<td>20</td>
<td>112</td>
</tr>
</tbody>
</table>

In order that school administrators may have understanding of the general standing of their students quartile ranges are given:

<table>
<thead>
<tr>
<th>Quartile Range</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>First quartile range</td>
<td>129 - 215</td>
</tr>
<tr>
<td>Second quartile range</td>
<td>112 - 128</td>
</tr>
<tr>
<td>Third quartile range</td>
<td>94 - 111</td>
</tr>
<tr>
<td>Fourth quartile range</td>
<td>21 - 93</td>
</tr>
</tbody>
</table>
ENGLISH TEST

In the parentheses to the left write the number of the word that comes closest in meaning to the underlined word.

( ) 1. insular position 1. hemisphere, 2. isolated, 3. insolated, 4. intact
( ) 2. didactic verse 1. with regular rime, 2. dictated, 3. instructive, 4. elegiac
( ) 3. chancelleries in Europe 1. embassies, 2. chandlers, 3. sanctuaries, 4. executives
( ) 4. itinerant laborors 1. radical in views, 2. iterative, 3. without settled residence, 4. without assured income
( ) 5. disgruntled conservatives 1. bad principled, 2. bad humored, 3. unselfish, 4. propagandized
( ) 6. third party perennial 1. never failing items, 2. perfection, 3. forecasts, 4. not standards
( ) 7. the present incumbent 1. electorate, 2. inculcator, 3. candidate, 4. officer
( ) 8. herald a shift in tactics 1. hide, 2. review, 3. usher in, 4. support
( ) 9. dismantling the program 1. stripping, 2. disparaging, 3. reorganizing, 4. displaying
( ) 10. buoyant optimism 1. unfailing, 2. diplomatic, 3. resilient, 4. heavy
To the left of each title place the number of the type of literature that it best represents.

1. Tom Sawyer
2. On His Blindness
3. Faerie Queene
4. Our Town
5. Beowulf
6. Jane Eyre
7. My Last Duchess
8. Evangeline
9. Hamlet
10. Git Along, Little Dogies

Types of literature
1. Drama
2. Dramatic monologue
3. Epic poetry
4. Sonnet
5. Allegorical romance
6. Narrative poetry
7. Ballad
8. Novel

Name of construction or part of speech

1. noun clause
2. infinitive
3. adjective
4. gerund
5. preposition
6. conjunction

Use of the construction or part of speech

a. appositive
b. direct object
c. subject
d. object of preposition
e. indirect object
f. subjective complement (That is a predicate noun or a predicate adjective)

In the parentheses to the left of each sentence indicate the name of the underlined construction by number and its use by letter.

( ) ( ) 1. Right now politicians the country over are
      enimated by one desire, to be re-elected.
( ) ( ) ( ) 2. There on the floor lay the unclaimed letter.
( ) ( ) ( ) 3. Give whoever comes first the choice seats.
( ) ( ) ( ) 4. It is true that the judges discarded all the
      poetry.
( ) ( ) ( ) 5. Swimming in the pool he most abhorred.
( ) ( ) ( ) 6. Boulder Dam has three uses: preventing floods,
      furnishing water for irrigation, and developing electric power.
( ) ( ) ( ) 7. The plan is to meet every Tuesday in small
      groups.
( ) ( ) ( ) 8. Strange tales he told to all of us night after
      night.
( ) ( ) ( ) 9. They left quietly during the second act.
In each of these groups there is one misspelled word. Place the number of that word in the parentheses before its group.

( ) 1. (1) repetition (2) preferred (3) sergeant
    (4) paralell
( ) 2. (1) privelege (2) loneliness (3) barbarous
    (4) muscle
( ) 3. (1) instance (2) quantity (3) prevailant
    (4) incinerate
( ) 4. (1) incidentally (2) all ready (3) sandwich
    (4) referred
( ) 5. (1) mathematics (2) ninety (3) seperate
    (4) intercede
( ) 6. (1) millionaire (2) cemetry (3) questionnaire
    (4) altogether
( ) 7. (1) all right (2) ally (3) perceive (4) severely
( ) 8. (1) forty (2) fourth (3) seize (4) personnel
( ) 9. (1) noticable (2) lovable (3) irresistible
    (4) permisible
( )10. (1) eccentric (2) ultimate (3) grammar (4) assistent
( )11. (1) intelligence (2) misrepresent (3) misspelled
    (4) dissatisfied
( )12. (1) evidently (2) accidentally (3) painfully
    (4) specifically
( )13. (1) accomodate (2) occurrence (3) accompany
    (4) embarrassment
( )14. (1) geniuses (2) radius (3) soloes (4) alumnus
( )15. (1) laboratory (2) library (3) government
    (4) restaurent
To the left of each phrase place the number of the item below that most appropriately applies to it.

1. Realistic portrayal of Norwegians settling in the Middle West.
3. Uses the fall of man as theme for notable work.
4. His novels show the need for prison reform and improvement in boarding schools of his time.
5. Always associated with the writer he admired and wrote about.
6. Prevalent in an age characterized by close observance of rules, interest in the ancients, conservatism, and conventionalism.
8. Wrote a touching account of his daughter's death.
9. Associated with freedom of expression, interest in nature, humanity, democracy.
10. Considered America's most intellectual (twentieth century) poet.
12. The theme is over vaulting ambition.
15. A contemporary American humorist.

1. Dickens
2. Milton
3. Frost
4. Classicism
5. Poe
6. Moby Dick
7. Quality
8. Robert Benchley
9. Macbeth
10. Boswell
11. E.A. Robinson
12. Giants in the Earth
13. Romanticism
14. W.A.White
15. Pepy's Diary
HISTORY

In the parentheses to the left of each statement write the number of the correct answer.

( ) 1. Puritanism was strongest in: (1) Virginia; (2) Pennsylvania; (3) Massachusetts.

( ) 2. The Continental Congress that adopted the Declaration of Independence was meeting in: (1) Boston; (2) Philadelphia; (3) Charleston.

( ) 3. Which of the following territories was not obtained by purchase: (1) Louisiana; (2) Florida; (3) Oregon territory; (4) Alaska.

( ) 4. The Monroe Doctrine was: (1) a law passed by Congress; (2) was a decision of the Supreme Court; (3) announcement by the president.

( ) 5. The famous ordinance of 1787 provided a plan of government for: (1) the thirteen colonies; (2) the Northwest Territory; (3) the Louisiana Purchase.

( ) 6. The Mormons were persecuted because they believed in: (1) communism; (2) polygamy; (3) slavery.

( ) 7. Soon after each of the following wars, except one, a military leader became president. Which was the exception? (1) Revolutionary War; (2) Civil War; (3) Spanish American War; (4) World's War 1.

( ) 8. The so-called Marshall Plan aims to: (1) pay national debt; (2) strengthen our military program; (3) re-establish order in Europe.

( ) 9. The Lincoln and Douglas debates were concerned with: (1) tariff; (2) government aid to railroads; (3) slavery.

( ) 10. Three of the following men were industrialists. Which one was not? (1) Andrew Carnegie; (2) John D. Rockefeller; (3) Samuel Gompers; (4) Henry Ford.

( ) 11. Labor has generally: (1) opposed immigration; (2) been indifferent to it; (3) favored it.

( ) 12. Jane Addams was well known as: (1) social worker; (2) a scientist; (3) a fiction writer.

( ) 13. Three of the following men were defeated by Franklin D. Roosevelt for president. Which one was not? (1) Herbert Hoover; (2) Alfred M. Landon; (3) Alfred Smith; (4) Wendell Wilkie.
HISTORY (Continued)

( )14. The number of presidents that have died in office has been: (1) 3; (2) 5; (3) 7; (4) 9.

( )15. Which of the following Latin expressions is not found in U. S. Constitution: (1) habeas corpus; (2) e pluribus unum; (3) pro tempore; (4) ex post facto.

( )16. Petrillo is the union leader of: (1) the steel workers; (2) the railroad engineers; (3) the musicians; (4) the coal miners.

( )17. Which one of the following four well known railroad systems does not enter Chicago: (1) N.Y.C.; (2) U.P.; (3) Penna.; (4) Sante Fe.

( )18. The "Good Neighbor Policy" was an expression that came into use under President: (1) Wilson; (2) Hoover; (3) Roosevelt; (4) Truman.

( )19. The expense of Columbus' first trip to America was paid by: (1) Italy; (2) France; (3) Spain; (4) England.

( )20. Valley Forge is an American shrine because it stands for: (1) a great invention; (2) a great skiing place; (3) a great sacrifice; (4) a great massacre by Indians.

Place a plus sign before a true statement and a minus sign before a false statement.

1. Religion had a marked influence on the early settlement of the United States.
2. The Mayflower compact was agreement by the Pilgrims to be loyal to their king.
3. At one time France controlled more of the North American Continent than did England.
4. In the colonial period agriculture was the chief occupation of the people.
5. The Huguenots were a group of religious people that came from Sweden.
6. The "Charter Oak" was located in New York.
7. The British Parliament passed laws that were intended to hamper the development of industry in the colonies.
8. Wisconsin was the first state to enter the union after the adoption of the U. S. Constitution.
9. Before the Revolutionary War nearly all the Indians were friendly to the colonists.
10. The Stamp Act was a form of taxation.
11. In the conflict between the king and the colonies, Patrick Henry favored the king.
12. The duel between Hamilton and Burr resulted from an insult Burr had given to Washington.
13. After the Constitution was adopted the Federal Government assumed responsibility for state debts resulting from the war.
14. Louisiana was purchased under Adam's administration.
15. John Marshall made his reputation as a great senator.
16. The people of the Mississippi Valley were favorable to the building of the Erie Canal.
17. Andrew Jackson was a military hero.
18. When the South seceded the population of the seceded states was greater than that of the Northern states.
19. At one time there were slaves in the North as well as in the South.
20. Birmingham Alabama is a great steel center.
21. Since 1900, the urban population in the U. S. has increased faster than the rural population.
22. Woodrow Wilson was the first president elected by the Democrats after the Civil War.
23. Tammany Hall is a great theatre in Philadelphia.
24. There was a panic in the U. S. in 1893.
25. The "Boxers" were a patriotic society in Japan.
26. Woman suffrage amendment was ratified during Hoover's administration.
27. In the early period of our war with Japan the Japanese were successful on all fronts.
28. During the Second World War, Italy became an ally of Germany.
29. The U. S. has now withdrawn all troops from Germany.
30. Since the Japanese were withdrawn from China, that country has enjoyed general peace and prosperity.
Place a plus sign before a true statement and a minus sign before a false statement.

1. Water expands when it freezes.  
2. The human heart has four chambers.  
3. The unit of weight in the metric system is the liter.  
4. The device for protecting lights and motors from an overcharging of electricity is called a switch.  
5. The spleen is an excretory organ.  
6. Orange juice is rich in protein.  
7. The watt is the unit of measurement of sound.  
8. Sound travels at the rate of 1500 ft. per second.  
9. The people in South Dakota are nearer to the sun now than they are in July.  
10. Druml in is a term that occurs in music.  
11. The intensity of light is proportional to the distance away from the light.  
12. Insulators are also good conductors.  
13. The milky way is a term that belongs to the field of physiology.  
14. Our solar system has eight planets.  
15. Gravity does not act upon objects in a vacuum.  
16. A kilogram is heavier than a pound.  
17. The planet nearest to the earth is mercury.  
18. No new elements have been discovered within the last twenty five years.  
19. Faults is a term used in the field of geology.  
20. The pitch of a sound depends upon number of vibrations per second.  
21. Neon lights have no filaments.  
22. The amoeba has no eyes.  
23. The circulation of the blood was discovered by Burbank.  
24. The chronometer is a device for measuring light.  
25. Infra red rays are shorter than ultra violet rays.

In the parentheses to the left of each statement write the number of the correct answer.

( ) 1. The planet that has the rings is: (1) Pluto; (2) Neptune; (3) Uranus; (4) Saturn.  
( ) 2. The amount of time for light to go from the earth to the moon would be about: (1) one second; (2) five seconds; (3) twenty seconds; (4) one hour and ten minutes.  
( ) 3. When the temperature is 10 below zero F., the reading on the centigrade scale would be about: (1) 10 above; (2) 5 below; (3) 23 below; (4) 42 below.  
( ) 4. Of the following metals the one that has the highest melting point is: (1) lead; (2) tin; (3) platinum; (4) gold.
SCIENCE (Continued)

5. The most common voltage on electric wires in houses is: (1) 60; (2) 110; (3) 220; (4) 510.

6. It has been calculated that the number of calories required per day for a man doing light work would be about: (1) 200 calories; (2) 1800 calories; (3) 3000 calories; (4) 5000 calories.

7. The lowest temperature that a mercury thermometer will register is: (1) -30°F; (2) -35°F; (3) -40°F; (4) -45°F.

8. Without an artificial supply of oxygen the human being is likely to lose consciousness at an elevation of about: (1) 20,000 ft.; (2) 30,000; (3) 40,000; (4) 50,000.

9. Jet propelled planes have been reported to have attained a speed of: (1) 450 m.p.h.; (2) 550 m.p.h.; (3) 640 m.p.h.; (4) 800 m.p.h.

10. The Geiger counter is used to record: (1) earthquake tremors; (2) radioactive material; (3) sun spot activity; (4) heart mummers.

Before each item on the left place the number of the proper item on the right.

1. The science of sound 1. cathode
2. An instrument to measure 2. isobar
   strength of an electric current
3. Watery fluid in the eye 3. lithosphere
4. Negative pole of a battery 4. moraine
5. Arrangement of stars in a 5. aqueous humor
   group
6. Substance in the blood 6. pupa
7. A line on a weather map 7. galaxy
8. Related to glaciers 8. sextant
   insect
10. Instrument for determining 10. ammeter
    latitude and longitude
11. The main solid part of the 11. tungsten
    earth
12. Particle carrying a positive 12. hemoglobin
    charge of electricity
13. Metal used in making electric 13. tympanum
    lamp filaments
14. A part of the ear 14. anemometer
15. A wind gauge 15. acoustics
MATHEMATICS

In the parentheses to the left of each statement write the number of the correct answer.

( ) 1. I buy stocks at 20% discount and sell them at 10% premium. My gain in per cent is: (1) 30%; (2) 37 1/2%; (3) 10%.

( ) 2. The boundary of a square and a circle are each 20 feet. The area of the circle will be greater than the square by about: (1) 5 sq. ft.; (2) 7 sq. ft.; (3) 9 sq. ft.

( ) 3. In five minutes the extreme end of a minute hand on a town clock moves 1.6 ft. The length of the hand is about: (1) 1.5 ft.; (2) 2 ft.; (3) 3 ft.

( ) 4. I sold my car for 20% gain; had it cost me $1,000 more I would have lost 20%. The car cost me: (1) $1,000; (2) $1,500; (3) $2,000.

( ) 5. A boat makes 15 miles per hour down stream and 10 miles per hour up stream. In nine hours it can go and return: (1) 40 miles; (2) 48 miles; (3) 54 miles; (4) 60 miles.

( ) 6. \( \frac{1}{2} \div \frac{2}{3} = \) (1) 5/24; (2) 3 1/3; (3) 1 2/3; (4) no correct answer.

( ) 7. \( 0.00064 \div 1.6 = \) (1) .004; (2) .0004; (3) .04; (4) no correct answer.

( ) 8. \( 1/2 \div .002 = \) (1) .0025; (2) 250; (3) 25; (4) no correct answer.

( ) 9. \( 4X-2(X^2) = \) (1) 2X-12; (2) 2X -1 12; (3) 3X -1 12; (4) no correct answer.

( ) 10. \( X^2-X(X-1) = \) (1) 2X^2 -X; (2) 2X^2 -X; (3) 2X^2 -1; (4) no correct answer.

( ) 11. \( X^2 + 1/X^2 = \) (1) 1; (2) X^4; (3) 1/X^4; (4) no correct answer.

( ) 12. A farmer has 130 rods of fence with which he wishes to enclose a rectangular field. If he makes the field 40 rods long the width must be: (1) 25 rods; (2) 35 rods; (3) 50 rods; (4) 65 rods.

( ) 13. After paying out 1/4 and 1/5 of my money, I had left $8.00 more than I spent. I must have had in the beginning: (1) $50; (2) $80; (3) $100; (4) $120.

( ) 14. When 3/5 is reduced to a fraction whose numerator is 8, the denominator would be: (1) 12 1/2; (2) 13 1/3; (3) 15 1/5.

( ) 15. By mixing 5 pounds of good sugar with 3 pounds worth 4 cents per pound less, the mixture is worth 8 1/2 cents per pound. The price of the good sugar was: (1) 10 cents; (2) 12 cents; (3) 15 cents; (4) 20 cents.
MATHEMATICS

Before each statement on the left, place the number of the proper answer on the right.

1. Volume of cone 1. $\frac{1}{3} \pi r^2h$
2. Area of triangle 2. $\pi d$
3. Circumference of circle 3. $\frac{1}{2}(b+b')h$
4. Surface of a cube 4. $\pi r^2$
5. Area of circle 5. $1/3 \pi r^2h$
6. Volume of a cylinder 6. $s^3$
7. Complimentary angles 7. $6s^2$
8. Area of a trapezoid 8. $a^2+b=90$ degrees
10. Area of parallelogram 10. $\pi r^2h$

Place a plus sign before a true statement and a minus sign before a false statement.

1. An acute angle is smaller than a right angle.
2. If the length of a side of a right triangle is known the hypotenuse can be found.
3. A reflex angle is greater than 180 degrees.
4. An arc is a segment of a circle.
5. The greater the number of sides of a polygon the greater the sum of the interior angles will be.
6. The sides of a rhombus are equal.
7. A root is always positive.
8. The two numbers of an equation need not always be equal.
9. The number 18 is a prime number.
10. The converse of any theorem is also true.
11. If the denominator of a fraction is increased the value of the fraction is decreased.
12. It is impossible to divide by 0.
13. $x^0=1$
14. $A^{-1}=1$
15. $\sqrt{x^2+y^2} = x^2-y^2$
MATHEMATICS (Continued)

After each trinomial, four expressions are given. One of these four is a factor of the trinomial. Indicate which one by placing its number in the parentheses before the trinomial.

( ) 1. \( n^2 + 5m + 6 \): (1) \( n^2 + 2 \); (2) \( n^4 \); (3) \( n^2 \); (4) \( n^4 + 5 \)
( ) 2. \( 3d^2 + 5d - 12 \): (1) \( 3d^2 + 3 \); (2) \( 3d - 6 \); (3) \( d^2 + 3 \); (4) \( d - 3 \).
( ) 3. \( 16a^2 - 24ab + 9b^2 \): (1) \( 8a - 3b \); (2) \( 4a^2 - 9b^2 \); (3) \( 4a - 3b \); (4) \( 4a - 3b \).
( ) 4. \( 8y^2 - 20y - 12 \): (1) \( 4y - 12 \); (2) \( 8y - 4 \); (3) \( 4y - 3 \); (4) \( 2y - 12 \).
( ) 5. \( 20b^2 + 25b^2 - 30b + 2x^2 \): (1) \( 4b^2 + 2x \); (2) \( 12b - 2x \); (3) \( 1 - x \); (4) \( 4b^2 + 1 \).

Select the proper answer and write the number of it in the parentheses to the left.

( ) 1. \( 3x - 7x - 2 \): (1) \( x = 1 \); (2) \( x = -5 \); (3) \( x = 2 \); (4) \( x = 5 \).
( ) 2. \( \frac{a^4}{a^1} = \frac{5}{2} \) : (1) \( 5 \); (2) \( 11 \); (3) \( 1 \).
( ) 3. \( 2x + y = -3 \) \( x - y = -9 \) : (1) \( y = 8 \); (2) \( y = -5 \); (3) \( y = 5 \); (4) \( y = 3 \).
( ) 4. \( 0.06b^4 - 0.02a^2 = 204 \) \( 0.05b^4 - 0.03a^4 = 186 \) : (1) \( a = 1000 \); (2) \( a = 1200 \); (3) \( a = 2000 \); (4) \( a = 3600 \).
( ) 5. \( x - 2y = 0 \) \( 5x - 8y = 12 \) : (1) \( x = 8 \); (2) \( x = 12 \); (3) \( x = 16 \); (4) \( x = 20 \).