Prediction of achievement of students in Bremen High School

Vernon Lewis Rauch
Iowa State University

Follow this and additional works at: http://lib.dr.iastate.edu/rtd

Part of the Educational Assessment, Evaluation, and Research Commons, and the Other Education Commons

Recommended Citation
http://lib.dr.iastate.edu/rtd/16377

This Thesis is brought to you for free and open access by Iowa State University Digital Repository. It has been accepted for inclusion in Retrospective Theses and Dissertations by an authorized administrator of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
PREDICTION OF ACHIEVEMENT OF STUDENTS
IN BREMEN HIGH SCHOOL

by

Vernon Lewis Rauch

A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
MASTER OF SCIENCE

Major Subject: Industrial Education

Signatures have been redacted for privacy

Iowa State University
Of Science and Technology
Ames, Iowa

1962
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>II. REVIEW OF LITERATURE</td>
<td>4</td>
</tr>
<tr>
<td>III. THE INVESTIGATION</td>
<td>9</td>
</tr>
<tr>
<td>A. Hypothesis</td>
<td>9</td>
</tr>
<tr>
<td>B. Scope and Basic Assumptions</td>
<td>10</td>
</tr>
<tr>
<td>C. Method of Procedure</td>
<td>11</td>
</tr>
<tr>
<td>D. Method of Solution</td>
<td>11</td>
</tr>
<tr>
<td>IV. PREDICTION FOR HIGH SCHOOL</td>
<td>14</td>
</tr>
<tr>
<td>V. SUMMARY</td>
<td>19</td>
</tr>
<tr>
<td>VI. DISCUSSION</td>
<td>21</td>
</tr>
<tr>
<td>VII. LITERATURE CITED</td>
<td>23</td>
</tr>
<tr>
<td>VIII. APPENDIX</td>
<td>24</td>
</tr>
</tbody>
</table>
I. INTRODUCTION

In recent years the guidance programs in our public schools have grown considerably. Much of this growth came about because educators, the public, and the increased diversity of our school population brought about by cultural and technological changes have realized the value of guidance to our youth and ultimately to the community and the nation. Because of the increasing number of students in our public school systems and the increasing emphasis upon rediscovering talented students in the mathematical and scientific fields, studies predicting academic achievement at the secondary school level would greatly aid high school counselors in the academic counseling of their students. Industry, higher education, and the defense departments have found that evaluation measures improve the accuracy of their prediction. Therefore prediction of academic success is needed during high school years.

Few research studies concerning the prediction of achievement for male students have been conducted on the secondary school level. Many prediction studies have been classified as defined by the Encyclopedia of Educational Research (1, p. 1038-39).

Prediction in the broadest sense of the word is the primary goal of scientific investigation whether in astronomy, chemistry, psychology, medicine, or education. The scientist studies phenomena
as found in nature or as manipulated in the laboratory so that he may more adequately predict the reactions or the future state of the material or organism in which he is interested. He studies the effect of various treatment or selection procedures on substances or organisms so that he can predict the effect of his manipulations on similar organisms and thus to a greater extent control his environment and mold it to man's purposes.

The social sciences, such as education and psychology, are concerned with prediction about the human organism itself, particularly in relation to its learning capacity, potential growth, success, and adjustment. By increasing man's ability to foretell human behavior under prescribed conditions, science makes possible for man to make decisions about future courses of action which have a greater probability of fulfilling his goals or purpose.

The purpose of this study was to determine the usefulness of the final year marks in ninth grade English, ninth grade social studies, ninth grade vocational survey industrial arts, and the scholastic aptitude (Intelligence Quotient hereafter referred to as IQ) score as prediction variables for developing a regression equation for predicting achievement in Bremen High School. The final grade represents the average of the first semester grade with the second semester grade. Another purpose was to provide the counselors with statistical evidence from which they could predict achievement of students in high school.

English, social studies, vocational survey industrial arts, and scholastic aptitude were selected because they are common to all male students taking industrial arts. Also,
previous investigations have indicated that school marks are better predictors of achievement than achievement tests. Cain, Michaelis and Burich (2) collected and summarized more than 300 coefficients of correlation showing teachers' marks as still being the best indicators of achievement in specific subjects.

Bremen High School, District 228, Cook County, Midlothian, Illinois, is located in the southwest suburban area of Chicago. This school has been in operation since 1953. At present the enrollment is approximately 2300 students with a staff of approximately 100. This is a comprehensive high school with seven major departments: English-Language Arts, Social Studies, Science, Mathematics, Industrial Arts, Business Education, and Physical Education, with general education as its primary goal.
II. REVIEW OF LITERATURE

Few prediction of achievement studies for male students have been made in the past on the secondary school level. Most of the studies have been predicting success as measured by their achievement in some specific subject area or in college. Only a few of these studies have utilized the actual course marks rather than standardized test scores for making predictions.

Long (3) in a study at West Seattle High School, Seattle, Washington, attempted to analyze the relationships between various junior high school data and subject marks in five technical-vocational high school subjects so as to forecast academic success in each of these areas. His variables were junior high school grade averages in language arts, mathematics, social studies, science, industrial arts, home economics, California Reading Test (reading vocabulary test scores and reading comprehension test scores), and IQ scores from the Otis Quick-Scoring Test of Mental Ability and the SRA Primary Mental Ability Test. Since IQ scores were used from two different tests, a conversion table was constructed for each test to convert the IQ scores into a standard score. The data were processed separately by sex with hope of improving accuracy of the prediction. Long found correlational data for all eight predictors, for the best predictor in each subject.
area, and for the best single predictor. The multiple coefficient of correlation computed for each area when using all eight variables did not improve significantly the predicting accuracy obtained by using only the three best predictors. In two areas, business education for boys and home economics for girls, the best single predictor was to be used since each was nearly as accurate as the multiple predictor. From this study Long determined that the best over-all predictor of success for boys and girls was junior high mathematics grade averages. Junior high social studies grade average contributed significantly for boys but not for girls. Junior high school science grade average had practically no value except in forecasting success in high school science. Reading comprehension scores contributed one of the best predictors; whereas reading vocabulary scores provided very little toward prediction of high school success. IQ was not as good an overall predictor for boys and girls as was mathematics grade averages or reading comprehension scores.

A study by Killam (4) was concerned with the prediction of achievement in three areas: general industries (an orientation course), woodshop, and mechanical drawing at Maine Township High Schools, Des Plaines and Park Ridge, Illinois. Course marks in each study were eighth grade English, mathematics, general science, and social studies. The best pre-
dictor for general industries was found to be eighth grade mathematics marks. The mathematics variable yielded a single correlation of 0.30, and a combination of all variables yielded a multiple correlation of 0.33. In the prediction for woodshop it was found that a multiple correlation of all variables was 0.36. It was also determined that the eighth grade mathematics score and the general science score combined could predict achievement in woodshop as well as from a combination of all four variables. A multiple correlation for mathematics and general science scores was 0.33. In prediction for mechanical drawing it was found that a combination of the eighth grade mathematics score and the social studies score could be made as well as from a combination of all four variables. All four variables combined yielded a multiple correlation of 0.57; whereas mathematics and the social studies combined yielded a single correlation of 0.52.

Fribourgh (5) attempted to predict achievement in the first semester of printing, auto-diesel, machine shop, and aviation engine courses at Des Moines Technical High School, Des Moines, Iowa. He found that trade and industrial shop marks could be used to predict achievement in three vocational shop courses. He also determined that this was the most valuable predictor used in the prediction of achievement in auto-diesel and machine shop courses. Other predictors used
were: Revised Minnesota Form Board Test Score, series MA; the Bennett Test of Mechanical Comprehension, Form AA; and the American Council on Education Psychological Examination, High School Edition. A combination of trade and industrial shop marks and the Revised Minnesota Form Board Test score proved to be the best predictor for the printing course. Either the Bennett Test of Mechanical Comprehension, Form AA or the American Council on Education Psychological Examination, High School Edition, could be used singly to predict achievement in the aviation engines course.

Howe (6) in a prediction of success in the aviation core area at Des Moines Technical High School, Des Moines, Iowa, found that the final grade received in the trade and industries orientation course could be used as a predictor. Other variables used but not significant were: the American Council on Education Psychological Examination L-score, Q-score, and Total score; the Revised Minnesota Paper Form Board Test, test score; the 10-B trade and industrial orientation, final grade.

Bentall (7) was concerned with the prediction of achievement in first semester senior high school mechanical drawing at Central High School, Sioux City, Iowa, by using course marks from junior high school subjects. The variables used were English marks, industrial arts marks, and social studies marks. A significant F value was found when using each of
the individual variables independently. Zero order coefficients of correlation for each of the variables were: English, 0.5880; social studies, 0.5849; and industrial arts, 0.4722. English and industrial arts marks were the best two variable combination with a multiple coefficient of 0.6414. When all three variables were used, the multiple coefficient of correlation was 0.6479.
III. THE INVESTIGATION

This investigation makes use of ninth grade marks in English, social studies, vocational survey industrial arts, and scholastic aptitude (IQ) scores from the California Test of Mental Maturity Short Form, 50S as prediction variables for developing regression equations. These courses were selected because they are common to all male students who take vocational survey industrial arts in high school and because previous investigations have shown teachers' marks to be good indicators of achievement.

The criterion for this study was success as determined by the cumulative high school grade point average at time of graduation.

A. Hypothesis

For purposes of statistical inference, the null hypothesis was postulated as follows: Ninth grade marks in English, social studies, vocational survey industrial arts, and the scholastic aptitude (IQ) scores of the California Test of Mental Maturity Short Form, 50S have no value in predicting success as measured by grade point average at time of graduation.

The tenability of the null hypothesis depends on the degree of significance found in the statistical treatment of the
data. The finding of a significant correlation would be reason to reject the hypothesis.

B. Scope and Basic Assumptions

Only students who had entered Bremen High School as ninth grade students were included. Students transferring either into high school or transferring out of high school were excluded from this investigation.

This study was limited also to male students who took vocational survey industrial arts as the industrial arts curriculum was so structured that female students were excluded.

The investigation was for the school years 1954-55, 1955-56, 1956-57, and included 176 cases.

It was necessary to assume, for purposes of this study, the following:

1. Final marks received in the courses selected are satisfactory indicators of achievement.

2. Classes involved were typical classes and the instructors' methods of teaching did not differ sufficiently to affect the study adversely.

3. The IQ scores are satisfactory indicators of scholastic aptitude.
4. The final cumulative high school grade point average as determined at the time of graduation is a satisfactory measure of achievement and a criterion measure.

C. Method of Procedure

All data included in this study were taken from the students' permanent records of the Bremen High School. According to the grade point system used at Bremen High School, course marks were given the following numerical values: A = 5, B = 4, C = 3, D = 2, and E = 1.

In the prediction of achievement, four variables were used consisting of ninth grade English marks, ninth grade social studies marks, ninth grade vocational survey industrial arts marks, and scholastic aptitude (IQ) scores. These were designated as: \( X_1, X_2, X_3, \) and \( X_4 \) respectively.

D. Method of Solution

The criterion was set up initially in the form of a normal equation in deviation form as given by Wert (8). Deviation values were computed from the raw scores and entered in each of the respective equations. The normal equation in deviation form appears below:
After substitution of proper values of the sums, sums of squares, and sums of the cross-products in the equations was made, they were solved by the simultaneous solution method.

When each of the values of "a" was found and proved by substituting them in the normal equation, it was possible to set up an Analysis of Regression table. By entry of the proper values into this table, it was possible to find the F values of the combined variables in the equation as well as the multiple coefficient of correlation.

By an analysis of sums of squares for regression the relative contribution for each of the variables was calculated.

The variable which had the least amount of contribution was dropped, and a new set of normal equations was set up using the three remaining variables. This set of equations was solved in the same manner as above. The normal three variable equation in deviation form appears as follows:
When the equation was solved and the new values of "a" were found and proved to be correct, an Analysis of Regression table was set up once again. The resulting loss from the eliminated variable was determined by the F value.

If the F value indicated a significant loss in predictive value when the variable was eliminated, the conclusion was made that it could not be dropped and that the four variable combination must be used as the predictor. If, however, the variable dropped indicated no significant loss, another variable would have to be dropped from the equation according to its percent of contribution. The solution would be carried on in the preceding manner using two normal equations. The same procedure would apply in testing the loss as previously used. Each variable was dropped in order of least contribution, until a significant loss resulted.

As soon as it was ascertained which variable or combination of variables was significant and their coefficients of correlation noted for prediction purposes, the problem was solved.
IV. PREDICTION FOR HIGH SCHOOL

The normal equation in deviation from appears below:

\[ \Sigma x_1y = a_1\Sigma x_1^2 + a_2\Sigma x_1x_2 + a_3\Sigma x_1x_3 + a_4\Sigma x_1x_4 \]

\[ \Sigma x_2y = a_1\Sigma x_2x_1 + a_2\Sigma x_2^2 + a_3\Sigma x_2x_3 + a_4\Sigma x_2x_4 \]

\[ \Sigma x_3y = a_1\Sigma x_3x_1 + a_2\Sigma x_3x_2 + a_3\Sigma x_3^2 + a_4\Sigma x_3x_4 \]

\[ \Sigma x_4y = a_1\Sigma x_4x_1 + a_2\Sigma x_4x_2 + a_3\Sigma x_4x_3 + a_4\Sigma x_4^2 \]

When the proper values of the sums, sums of squares, and sums of cross-products were substituted into the normal equation, the equations as they appeared ready for simultaneous solution were as follows:

\[ 92.49202 = 186.357955a_1 + 113.6875a_2 + 98.994319a_3 + 1244.4091a_4 \]

\[ 79.764394 = 113.6875a_1 + 126.8125a_2 + 80.6875a_3 + 986.5a_4 \]

\[ 75.890111 = 98.994319a_1 + 80.6875a_2 + 122.539773a_3 + 868.1364a_4 \]

\[ 893.54973 = 1244.4091a_1 + 986.5a_2 + 1364a_3 + 27486.182a_4 \]

After simultaneous solution, the following "a" values were found:

\[ a_1 = 0.1259947987 \]
\[ a_2 = 0.2757354475 \]
\[ a_3 = 0.2784912792 \]
\[ a_4 = 0.0091134115 \]
The substitution of these values into the original normal equation proved that they were correct.

At this point an Analysis of Regression table was constructed and appeared as follows:

Table 1. Analysis of regression of English, social studies, vocational survey industrial arts, and scholastic aptitude for high school

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4</td>
<td>62.030962</td>
<td>15.507740</td>
<td>152.98</td>
</tr>
<tr>
<td>Residuals</td>
<td>171</td>
<td>17.334234</td>
<td>0.101370</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>175</td>
<td>79.365196</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following F and R values were found:

\[ F_{4,171} = 3.43 \quad F = 152.98 \quad \text{Ry}(1,2,3,4) = 0.8841 \]

Since the calculated value of F was greater than the table values, it was considered to be highly significant beyond the 1% level. This meant that a combination of all four variables could be used for predictive purposes.

The multiple coefficient of correlation for the combination of all four variables was 0.88417.
By an analysis of sums of squares for regression the relative contribution for each of the variables was calculated as follows:

- **English**  \( x_1 = 18.79\% \)
- **Social studies**  \( x_2 = 35.46\% \)
- **Vocational survey industrial arts**  \( x_3 = 34.07\% \)
- **Scholastic aptitude**  \( x_4 = 11.69\% \)
- **Total**  \( = 100.01\% \)

Because of the relatively minor contribution of the \( x_4 \) variable, it was eliminated and the resulting equations in deviation form was as follows:

\[
\begin{align*}
\sum x_1 y & = a_1 \sum x_1^2 + a_2 \sum x_1 x_2 + a_3 \sum x_1 x_3 \\
\sum x_2 y & = a_1 \sum x_1 x_2 + a_2 \sum x_2^2 + a_3 \sum x_2 x_3 \\
\sum x_3 y & = a_1 \sum x_1 x_3 + a_2 \sum x_2 x_3 + a_3 \sum x_3^2
\end{align*}
\]

When the proper values had been substituted into the normal equation, the equations as they appeared ready for simultaneous solution were as follows:

\[
\begin{align*}
92.49202 & = 186.357955a_1 + 113.6875a_2 + 98.994319a_3 \\
79.764394 & = 113.6875a_1 + 126.8125a_2 + 80.6875a_3 \\
75.890111 & = 98.994319a_1 + 80.6875a_2 + 122.539773a_3
\end{align*}
\]

After simultaneous solution, the following "a" values were found:


\[ a_1 = 0.1554110972 \]
\[ a_2 = 0.3020477863 \]
\[ a_3 = 0.2948741733 \]

The substitution of these values into the original normal equation proved that they were correct.

At this point an Analysis of Regression table was constructed and appeared as follows:

Table 2. Analysis of regression on English, social studies, and vocational survey industrial arts for high school

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Degrees of freedom</th>
<th>Sum of squares</th>
<th>Mean of squares</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression (4 variables)</td>
<td>4</td>
<td>62.030962</td>
<td>15.507740</td>
<td></td>
</tr>
<tr>
<td>Regression (3 variables)</td>
<td>3</td>
<td>60.844979</td>
<td>20.281660</td>
<td></td>
</tr>
<tr>
<td>Loss ((X_4))</td>
<td>1</td>
<td>1.185983</td>
<td>1.185983</td>
<td>11.70</td>
</tr>
<tr>
<td>Residuals</td>
<td>171</td>
<td>17.334234</td>
<td>0.101370</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>175</td>
<td>79.365196</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following \( F \) and \( R \) values were found:

\[ F_{1,171} = 3.91 \]
\[ F = 11.70 \]
\[ R_Y(1,2,3) = 0.8755 \]

Since the calculated value of \( F \) was greater than the table values, it was considered to be highly significant at the 1%
level. This meant that the loss of the scholastic aptitude variable from the equations would affect its ability to predict and should not be eliminated.

The multiple coefficient of correlation for the combination of three variables was 0.8755.

Because of the foregoing calculations it was concluded that the scholastic aptitude variable could not be dropped, and that achievement in high school must be predicted from the combination of all four variables.

The following formula is used for conversion of the deviation values to raw scores:

\[ y = a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 \]

\[ (Y-Y) = a_1(x_1-x_1) + a_2(x_2-x_2) + a_3(x_3-x_3) + a_4(x_4-x_4) \]

Substituting the "a" values and solving:

\[ Y=0.1259947987X_1+0.2757354475X_2+0.2784912792X_3+0.0081124115X_4 \]
V. SUMMARY

This investigation was conducted to determine the prediction ability of ninth grade English, social studies, vocational survey industrial arts, and scholastic aptitude in predicting achievement in high school at Bremen High School, Midlothian, Illinois. Each of the variables made use of average ninth grade final marks, and the criterion made use of the cumulative high school grade point average at time of graduation.

The data for the investigation were gathered from the students' permanent records of the Bremen High School. The study included 176 cases covering the school years of 1954-55, 1955-56, and 1956-57.

In statistically treating the data for prediction in high school, it was found that all four variables combined must be used for prediction. The combined variables yielded a multiple coefficient of correlation of 0.8841.

By an analysis of sums of squares for regression the relative contribution for each of the variables was calculated. Social studies (X₂ variable) contributed the most with 35.46 percent. The X₃ variable, vocational survey industrial arts, contributed 34.07 percent. English, the X₁ variable, was third in contribution with 18.79 percent. The X₄ variable,
scholastic aptitude, contributed the least with 11.69 percent. The percent of contribution of each variable was great enough that it had to be used in the prediction.
VI. DISCUSSION

The purposes of general education are to prepare students for a satisfying personal life, happy family and social relationships, and responsible citizenship in a free society. This is accomplished by developing skills, abilities, attitudes, and values which will enable them to cope more effectively with their personal problems and those of the society in which they live.

The role of the counselor is not primarily to make decisions but rather to assist the counselee in obtaining a better understanding of his aims and motives as well as his potentialities so that he can make more satisfying decisions. In education homogeneous grouping of students, selection of college applicants, determination of appropriate vocational choice, and drop-out students illustrate the varied need for prediction studies.

The coefficient of correlation of the four variables combined was 0.8841 which is considered high. This could be interpreted that the sample selected was indiscrete, the differences in socio-economic backgrounds were negligible, or that the teachers were stimulating interest in the students and meeting their needs.

It is interesting to note that two variables, social
studies and vocational survey industrial arts contributed 35.46 percent and 34.07 percent respectively, whereas English and scholastic aptitude contributed 18.79 percent and 11.69 percent respectively. Many factors could contribute to these differences. Individual and sex differences would probably have the most effect. Other factors could be the genetic and environmental background and educational practices of teachers and their standards. As this study was related only to boys who have taken vocational survey industrial arts, speculation can be made that social studies and industrial arts were more appealing and interesting to them. Boys often express a lack of interest in English which could have an effect on the percent of contribution made to this study. Scholastic aptitude is not an absolute value but is only an indication of the mid-points in a range. Many students of varied scholastic aptitude achieve to a greater or lesser degree than others. This could account for the relatively low contribution of this variable.

The counselor should find this study useful in the prediction of success in high school. Even more important would be the use the counselor could make of this study in helping the slow learners and those of low scholastic ability to achieve a degree of success in high school. This would help to lower the number of drop-out students.
VII. LITERATURE CITED


VIII. APPENDIX
### Table 3. Values of the raw scores

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Raw scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Σx₁</td>
<td>English</td>
</tr>
<tr>
<td>Σx₂</td>
<td>Social studies</td>
</tr>
<tr>
<td>Σx₃</td>
<td>Vocational survey industrial arts</td>
</tr>
<tr>
<td>Σx₄</td>
<td>Scholastic aptitude</td>
</tr>
<tr>
<td>Σx₂⁺</td>
<td>1,373</td>
</tr>
<tr>
<td>Σx₂⁻</td>
<td>1,519</td>
</tr>
<tr>
<td>Σx₂⁻⁻</td>
<td>2,067</td>
</tr>
<tr>
<td>Σx₂⁻⁻⁻</td>
<td>1,919,472</td>
</tr>
<tr>
<td>Σx₁ₓ₂</td>
<td>1,399</td>
</tr>
<tr>
<td>Σx₁ₓ₃</td>
<td>1,618</td>
</tr>
<tr>
<td>Σx₁ₓ₄</td>
<td>48,627</td>
</tr>
<tr>
<td>Σx₂ₓ₃</td>
<td>1,726</td>
</tr>
<tr>
<td>Σx₂ₓ₄</td>
<td>52,309</td>
</tr>
<tr>
<td>Σx₃ₓ₄</td>
<td>61,532</td>
</tr>
<tr>
<td>Σy₁</td>
<td>526.1109</td>
</tr>
<tr>
<td>Σy₂</td>
<td>1,652.050872</td>
</tr>
<tr>
<td>Σx₁y</td>
<td>1,458.5968</td>
</tr>
<tr>
<td>Σx₂y</td>
<td>1,559.4513</td>
</tr>
<tr>
<td>Σx₃y</td>
<td>1,624.6110</td>
</tr>
<tr>
<td>Σx₄y</td>
<td>55,441.6844</td>
</tr>
</tbody>
</table>

N: 176

### Table 4. Values of the deviation scores

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Deviation scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Σx₁²</td>
<td>186.357955</td>
</tr>
<tr>
<td>Σx₂²</td>
<td>126.8125</td>
</tr>
<tr>
<td>Σx₃²</td>
<td>123.539773</td>
</tr>
<tr>
<td>Σx₄²</td>
<td>27,486.182</td>
</tr>
<tr>
<td>Σx₁ₓ₂</td>
<td>113.6875</td>
</tr>
<tr>
<td>Σx₁ₓ₃</td>
<td>98.994319</td>
</tr>
<tr>
<td>Σx₁ₓ₄</td>
<td>1,244.4091</td>
</tr>
<tr>
<td>Σx₂ₓ₃</td>
<td>80.6875</td>
</tr>
<tr>
<td>Σx₂ₓ₄</td>
<td>986.5</td>
</tr>
<tr>
<td>Σx₃ₓ₄</td>
<td>868.1364</td>
</tr>
</tbody>
</table>
Table 4. (Continued)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Deviation scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Sigma y^2$</td>
<td>79.365196</td>
</tr>
<tr>
<td>$\Sigma x_1y$</td>
<td>92.49202</td>
</tr>
<tr>
<td>$\Sigma x_2y$</td>
<td>79.764394</td>
</tr>
<tr>
<td>$\Sigma x_3y$</td>
<td>75.890111</td>
</tr>
<tr>
<td>$\Sigma x_4y$</td>
<td>893.54973</td>
</tr>
</tbody>
</table>