HAROLD O. RUGG. *Statistical Methods Applied to Education*. Riverside Textbooks in Education. Boston: Houghton Mifflin Co., 1917. Pp. xviii, 410. \$2.00.

What Horace Mann did in 1843 for educational statistics Rugg now has done in 1917. Over half a century ago the need for a quantitative expression of educational conditions made itself felt. But it was not without a great deal of general opposition that Mann was able to accomplish what he did. At the present time, however, we find school people, with few rare exceptions, more than favorable to a statistical treatment of educational facts. Indeed that administrator who has no need for refined methods of evaluating school results is as difficult to find as the now famous needle in the haystack. The book fills a long felt need, and will undoubtedly help trace a new high-water mark in education.

The plan and purpose of the book is outlined in the preface. Rugg has assumed "that it is necessary to equip school men, generally, with a thorough-going knowledge of statistical methods; that in order for them to be discriminating in the use of the various methods in improving their school practice, this large background of knowledge must be developed; and that it is possible to explain rather completely the reasons for and the significance of the principal statistical devices without expressing the explanation in technical mathematical language." When the student turns the last page of the book he is convinced that Rugg has made these statements good.

The first three chapters of the book are devoted to a discussion of the statistical methods in education, the collection of educational facts, and the tabulation of educational data. A brief survey is made of recent quantitative educational literature and its importance is emphasized in the light of administrative and pedagogical-experimental problems. The necessary steps in educational research are then outlined, and the sources for the collection of data indicated. These sources have now been amply supplemented by the author in the current numbers of "The School Review" and "The Elementary School Journal." It is also gratifying to find a very critical presentation of the importance of the questionnaire, and the guiding principles which should underlie its preparation. Questions relating to various methods of tabulation are discussed, and a brief description of the Hollerith system is given. One regrets finding no mention of the excellent Findex system, nor of some of the other labor saving devices, such as the slide-rule, comptometer, Brunsviga, space probably being prohibitive.

The next three chapters initiate one into the statistical treatment of educational data. The frequency distribution, the method of averages and the measures of variability are discussed. The terms "unit," "scale," "frequency," "class interval," etc., are explained and illustrated. The chapter on averages is a very valuable one, especially because of the emphasis on uniform terminology and the discussion concerning the relative merits and demerits of the various averages. The reviewer has not been convinced however, that to calculate the median, $\frac{N}{2}$ should be used in pre-

ference to $\frac{N+1}{2}$. In view of Meitzen's discussion this change might lead to erroneous results when interpolating (by formula) the values for the different cases in a given class interval. Two of us are now at work on this problem and our results will be published shortly. In stating the formula for the harmonic mean Rugg gives the one most commonly used,

$$\frac{1}{H} = \frac{1}{N} \sum \left(\frac{1}{m} \right)$$

The reviewer has simplified this formula:

$$H = \frac{N}{\sum (1/m)}$$

thus facilitating its understanding and computation. The chapter on the measure of variability is an excellent illustration of how an apparently difficult subject matter may be clearly explained if only the author take sufficient pains to think and write plainly and succinctly. The average deviation, the standard deviation, the quartile deviation, the probable error, the semi-interquartile range, the various coefficients of variation and of skewness are interpreted in the light of the normal frequency surface and their calculation illustrated. It seems to the reviewer that it might have been well to indicate that for few cases the standard deviation should be calculated from the formula:

$$\sigma = \frac{\sqrt{\sum f d^2}}{N - 1}$$

according to the method of least squares, and under coefficients of variability a consideration of the formula:

$$C. V. = \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

would have added to the value of the paragraphs dealing with those specific items.

In the next two chapters the normal frequency surface and the use of the normal frequency curve in education are considered. In using the book with students one misses a discussion of the ogive and its relation to the normal frequency surface. Especially is this true in connection with a study of percentile grading. And here, if I may be permitted to digress, a good portion of the recent work with percentiles is invalid because the ogive and not the frequency surface has been utilized as the base of reference. The major portion of the chapter is devoted to probability, and every bit of it is worth while, since probability is the foundation upon which our whole statistical structure is based. As homely as the comparison may appear, it may be said with justice, that every statistical problem in education brings us back to the question of "tossing pennies." The chapter on the use of the normal frequency curve in education is replete with applications to everyday school problems.

Chapter IX is devoted to a consideration of the measurement of relationship, or correlation. The various methods are indicated and practical applications made. Galton's graphic method, the Pearson coefficient by the long and short methods, the Spearman foot-rule and rank differences formulae, the Pearson *eta* method, the four-fold table, unlike signs and contingency methods are all given. No mention is made of Yule's recent improvement of his Q method. His present coefficient of colligation (ω) is superior to some of the other "association" methods, and far easier to compute. The regression coefficient and the regression equation, their meaning and significance are explained. In the discussion of non-linear regression only one of the *elás* is mentioned, η_y , nothing being said regarding the other *eta*, η_x , which is equally important. Thus in one of W. Brown's articles (Brit. J. Psychol. Vol. 6,

p. 236-237), the Pearson coefficient is $+.033 \pm .030$, *etc* y is $+.323 \pm .027$, and *etc* x is $+.182 \pm .029$. This fact should be taken into account when using Blakeman's test for linearity. No space is given to Spearman's correction formula, Rugg being skeptical as to its value. He would be inclined to agree with those who maintain that by making measurements more efficient, correction will be unnecessary. But how can we tell whether measurements are really efficient unless we use a correction formula? To quote Spearman, "The suggestion is like telling a man to brush his coat until it is clean but never look whether it is so." The corrected coefficient is especially necessary when attempting to find the true probable error of

a correlation coefficient. True P. E. = $\frac{P. E. r \times r_{pq}}{r}$. These remarks, however, are not meant to detract from Rugg's very masterly presentation of the measurement of relationship, for he has crowded within a comparatively few pages material which is practically inaccessible to the average school man.

The last chapter of the book is in many respects its most unique feature. Everyone interested in "getting facts across" should not fail to read these valuable pages. Figures mean nothing to the statistically uninitiated unless presented in graphic form. These fifty pages are a gold mine of illustrative material.

Other features of great value are a tabular review of quantitative studies on school administration, together with a bibliography of 165 titles, brought to date; a selected bibliography on statistical methods; a set of illustrative problems at the end of most of the chapters; a summary of formulae and symbols used in the text; and ten tables to facilitate computation. There are several typographical errors in the text and tables which a revised edition will eliminate.

The editor of the Riverside Textbooks in Education has not in the least overdrawn the merits of the book when he stated that "The volume represents a very successful attempt to produce a book which will apply the mathematical theory of statistical work to educational problems, and as such it should find a hearty welcome from the teachers of education in universities, colleges, and normal schools, educational investigators generally and school officials interested in making the best of statistical data and displaying the results to their supporting public in the most effective graphic form."

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