Report 1925-26 With the Supplement to the Guide to the Experimental Plots
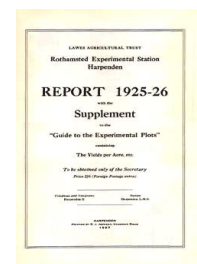
Statistical Methods and Results

Rothamsted Research

XI.   H. LLOYD HIND, H. THREADGOLD and C. W. B.
ARNOLD. " *The Determination of the Diastatic Power
of Malt and Barley*." Journal of the Institute of Brewing, 1926, Vol. XXXII., pp. 26-32.

An improvement in the standard method of determination of diastatic power, by working at a constant hydrogen ion concentration corresponding to pH 4.6, obtained by the addition of an acetate buffer.

XII.   R. G. WARREN, C. T. GIMINGHAM and H. J. PAGE.
" *The Chemistry of Basic Slag I.   The Determination
of Fluorine in Basic Slag*." Journal of Agricultural Science, 1925, Vol. XV., pp. 516-528.

A method is described for the determination of fluorine in basic slag.   The fluorine content and the citric solubility of a number of basic slags are compared.   On the assumption that fluorine in basic slag locks up in an unavailable condition an equivalent amount of phosphate, in the form of fluorapatite $[Ca_3 (PO_4)_2]_3 CaF_2$, an " availability value " is calculated from the fluorine content.   In general, the values so obtained run parallel with the citric solubilities, but certain discrepancies occur, which will form the subject of further work.

II.   STATISTICAL METHODS & RESULTS.

(Statistical Department.)

XIII.   R. A. FISHER. " *Theory of Statistical Estimation*."
Proceedings of the Cambridge Philosophical Society, 1925, Vol. XXII., pp. 700-725.

An ordered exposition of the recent developments of the theory of statistical estimation, and of the criteria which now exist for judging the value of statistical methods.   The properties, first of consistent, and then of efficient statistics, are deduced, and a general method is given of obtaining an efficient statistic without the solution of transcendental equations.   A property of efficient statistics is utilised to supply a measure of the intrinsic accuracy of error distributions, and this in turn to extend the notion of efficiency to statistics derived from small samples.   The peculiar character of statistical estimates classed as sufficient is elucidated ; and, in the absence of these, a method is given of evaluating the loss of information involved in the maximum likelihood solution, and of other efficient statistics.   Finally, it is shown how ancillary statistics may be used to remove this residual loss of information.

XIV.   P. R. ANSELL and R. A. FISHER.   " *Note on the
Numerical Evaluation of a Bessel Function Derivative*."
Proceedings of the London Mathematical Society, June 1925.

In the evaluation of a numerical expression involving the derivative of a Bessel function with respect to its modulus, it was found to be expressible in terms of the cosine-integral tabulated by

Glaisher. This suggested the possibility that a general relationship, hitherto unsuspected, might subsist between the two functions. On examination, such was found to be the case, and in the present note the derivative, for values of the modulus equal to the halves of odd integers, is expressed in terms of the sine— and cosine—integrals.

XV.   R. A. FISHER. *" The Resemblance between Twins, a Statistical Examination of Lauterbach's Measurements."* Genetics, 1925, Vol. X., pp. 569-579.

Previous data on the resemblance between human twins, though somewhat scanty, have shown themselves upon examination in surprising disaccord with the current biological theory of their origin. In this paper the extensive series of measurements obtained by Lauterbach has been examined, and is found on each point to be in substantial agreement with biological theory. There is every indication, within the group of like-sex twins, of a considerable class of genetically identical pairs, the correlation between whose measurements is found to be about .92; moreover, in the absence of errors of measurement, an even higher degree of resemblance is indicated.

XVI.   R. A. FISHER. *" Sur la Solution de l'equation Integrale de M. V. Romanovsky."* Comptes Rendus de l'Academie des Sciences, 1925, Vol. CLXXXI., pp. 88-89.

The Russian mathematician Romanovsky had expressed the distributions obtained by sampling the normal frequency surface in the form of an integral equation. The present note gives the solution of the equation and demonstrates its agreement with the distributions previously obtained by the author, from considerations of the geometry of Euclidean hyper-space.

XVII.   L. H. C. TIPPETT. *" On the Effect of Sunshine on Wheat Yield at Rothamsted."* Journal of Agricultural Science, 1926, Vol. XVI., pp. 159-165.

The object of this enquiry was to ascertain to what extent, if any, the apparent deleterious effect of rainfall upon the yield of wheat at Rothamsted should be ascribed to associated lack of sunshine, and in so far as the records would allow to evaluate the independent effect of the latter. The method employed was to utilise the effects of rainfall previously obtained for the whole 70-year period, and from the 34 years' sunshine records to obtain (i) the regression and residuals of sunshine upon rainfall, and (ii) the regression of crop residuals upon sunshine residuals.

The correlation of rain and sunshine is only about 0.23, and the effect ascribable to rain is in all essential features unchanged; a small proportion of the harmful effect of rainy weather from April to August should, however, be ascribed to associated lack of sunshine. The predominant effect of sunshine appears, however, to be in the end of autumn (October-December), suggesting that bright weather is important at this season in germinating the seed and establishing the seedling plants.

XVIII. W. A. MACKENZIE. *" Note on a Remarkable Correlation between Grain and Straw, obtained at Rothamsted."* Journal of Agricultural Science, 1926, Vol. XVI., pp. 275-279.

A considerable amount of unpublished material has in the past been accumulated at Rothamsted upon the important subject of the correlation between grain and straw from cereal crops; when the yields from a recent uniformity trial with wheat (Sawyers Field) were examined, it was therefore at once observed that the grain and straw were there correlated in quite an exceptional degree. The correlation was found to be no less than 0.990, and in the present paper the significance of such a result is examined in relation (i) to the uniformity of the field, and (ii) to the accuracy of the newly-established methods of plot technique.

XIX. R. A. FISHER. *" Baye's Theorem and the Fourfold Table."* The Eugenics Review, 1926, Vol. XVIII., pp. 32-33.

Considerable statistical controversy has been aroused on the question of the distribution of a certain quantity X^2, necessary to test the independence, when calculated from a fourfold table. Prof. Pearson's original theory that its mean value is 3, having been disputed upon different grounds by Yule and Fisher, who agree that the mean value must be unity. In the present note, the large number of 11,668 fourfold tables, put on record in a recent paper by Mr. E. S. Pearson, is utilised to test the point. The 17 averages obtained range from 0.8926 to 1.0882, the general average being almost exactly unity.

XX. R. A. FISHER. *" On the Random Sequence."* Quarterly Journal of the Royal Meteorological Society, 1926, Vol. LII., p. 250.

The " runs " of increasing or decreasing sequences which occur in a series of numbers arranged in random order are of some interest to meteorologists. This note gives the mathematical distributions of the frequency of length of run.

XXI. R. A. FISHER. *" Applications of ' Student's ' Distribution."* Metron, 1926, Vol. V., pp. 90-104.

XXI. (a) R. A. FISHER. *" Expansion of ' Student's ' Integral in Powers of n^{-1}."* Metron, 1926, Vol. V., pp. 109-112.

The increasing use, both in agriculture and in general statistics, of the error distributions discovered by " Student " in 1908, has created a need for improved tables. The opportunity of their preparation by that writer was taken of publishing simultaneously a comprehensive account of the numerous applications to which his methods have since been shown to be adequate. The first of these papers explains and illustrates the several groups of problems, of which an exact solution is provided by the tables; the second gives the expansion formula by which values outside the range of the tables may be calculated, and in parts of the region tabulated increased accuracy attained.