ABSTRACTS OF PAPERS PRESENTED AT THE 10th ANNUAL GENERAL MEETING OF THE SOCIETY HELD AT LUCKNOW

1. *A Balanced Design with Unequal Replications Within Block. M. N. Das, Indian Council of Agricultural Research, New Delhi.*

A design with three types of replications of the different treatments in any block, *viz.*, n, s and $s + p$ not all simultaneously zero, has been defined. When each of n and s is zero and p is equal to unity, it turns out to be the usual balanced incomplete block design. A method of analysis suitable for the general design has also been evolved together with an expression for finding the variance of the difference between treatment estimates.

2. *Analysis of a Long-term Manurial-*cum-*Rotational Experiment. V. G. Panse and T. P. Abraham, Indian Council of Agricultural Research, New Delhi.*

A long-term experiment designed to test the effect of different frequencies of manuring and to compare different sources of nitrogen on fixed 3 and 4 course rotations has been in progress at the Institute of Plant Industry, Indore, since 1949. A split plot design was used. The present paper describes the statistical analysis of the data for two complete cycles of the 3 course rotation and one cycle of the 4 course rotation. Estimates of the mean responses to treatments in different phases, and their rates of change along with the appropriate standard errors have been calculated. The design of the experiment was such that for some of the comparisons both intra-main plot and inter-main plot estimates could be obtained, and these were combined suitably to obtain efficient estimates.

3. *Pre-Harvest Estimation of Acreage under Wheat. A. R. Sen and R. K. Khosla, Indian Council of Agricultural Research, New Delhi.*

This paper deals with an empirical investigation of various single-stage sampling systems for pre-harvest estimation of acreage under wheat. The study has in the first instance been confined to Lucknow District. The final forecast figures for 1950–51 were used for selection and estimation purposes. The observed data were the results for 1951–52 figures. Two villages were selected from a patwari circle

(i) with probability proportional to the acreage under wheat during 1950–51 and with replacement, (ii) with probability proportional to the acreage under wheat during 1950–51 and without replacement, (iii) the first village selected with probability proportional to the acreage under wheat and second with equal probability from among the remaining units, and (iv) by simple random sampling using a ratio estimate. The efficiencies of these sampling systems were compared for the various subdivisions of the district.

4. *On Efficiency of Cluster Sampling. Daroga Singh, Indian Council of Agricultural Research, New Delhi.*

The efficiency of cluster sampling has been examined in relation to that of sub-sampling. It has been shown that in many surveys where the travelling expenditure between two second-stage units is considerable, it is worth while to go in for one-stage cluster sampling, a cluster consisting of second-stage units. There appears to be not much advantage in adopting two-stage cluster sampling (selection of clusters of second-stage units at the second stage) over that of sub-sampling, unless, for the fixed cost of the survey, the average travelling expenditure between two second-stage units in the sample is relatively much larger than the average cost per second-stage unit and the intra-class correlation is not high.

5. *Efficiency of Stratification in Sub-sampling Designs with Varying Probabilities of Selection for the Ratio Method of Estimation. H. K. Chawla, Indian Council of Agricultural Research, New Delhi.*

Mokashi (1954) has worked out the efficiency of stratification in sub-sampling for the Ratio Method of Estimation. Further efforts have been made in this paper to determine the gain in efficiency due to stratification when primary units are selected with probability proportional to some measure.

6. *Efficiency of Stratification in Sub-sampling Designs for the Ratio Method of Estimation with Varying Probabilities of Selection. J. N. K. Rao, Forest Research Institute, Dehra Dun.*

Mokashi (1954) has worked out the efficiency of stratification for the ratio method of estimation with equal probabilities of selection in sub-sampling designs, when supplementary information is available such as the yield records of the previous year. Following Sukhatme (1954), formulæ are developed in this paper, to estimate the efficiency of stratification for the ratio method of estimation when sampling is done with varying probabilities of selection and with replacement.

7. *Number of Genetic Factors and Response to Selection. V. G. Panse and R. C. Khanna, Indian Council of Agricultural Research, New Delhi.*

The study is made on the material collected from the experiments on cotton conducted at the Institute of Plant Industry, Indore. Selection has been continued in six crosses in the two directions of high and low staple length from the third generation onwards. The number of effective factors estimated both by Student's and Panse's methods is small and identical and is of the order of four in almost all the crosses. The response to selection is, however, not in keeping with the small number of factors as it is continuing beyond the thirteenth generation. The possible explanation is that the genetic set-up consists of a larger number of closely linked genes of varying magnitudes, represented in inheritance by a fewer number of factors of equal magnitude and segregating independently. The response to selection in the later generations is due to recombinations taking place within the effective factors.

Another aspect studied is the asymmetrical response to selection, there being no response to selection in the low line beyond the third selected generation. The observed asymmetry cannot be assigned to the difference in selection differential or the choice of a defective scale. The asymmetry is genetic and its explanation has to be sought either in unequal gene frequency or directional dominance or both.

8. *A Note on the Estimation of Mean Rate of Change. K. R. Nair, Forest Research Institute, Dehra Dun.*

The paper shows that the relative efficiency of a method of estimating the mean rate of change of a dependent variable y with change in an independent variable x recently suggested by Askovitz (*Science*, March 32, 1956) is:

$$\frac{3n}{4(n+1)} \frac{g_x^2}{s_x^2}$$

where g_x and s_x are respectively Gini's mean difference and the standard deviation of the n observed values of x. This relative efficiency is unity when the x's are equally spaced in which case the above method is identical to the least square method of estimating the linear regression coefficient of y on x. When x's are not equally spaced the relative efficiency is less than unity but its lower limit has not been found out.

9. *The Asymptotic Efficiency of Wald-Wolfowitz Run Test. B. V. Sukhatme, Indian Council of Agricultural Research, New Delhi.*

Wald and Wolfowitz suggested a test based on runs for testing the significance of two samples. They also gave an approximate expression for the mean of the limiting distribution of the test statistics under the alternative hypothesis to which objection has been raised by Savage and others. This paper gives an alternative expression for the test statistic in terms of ranks. The exact expressions for the mean and the variance of the test statistic under the alternative hypothesis have also been obtained. Using these results it is found that under certain conditions the asymptotic efficiency of the run test with respect to Student's test is zero.

10. *On the Power and Applications of Certain Distribution-Free Tests. B. N. Singh, Indian Standards Institution, New Delhi.*

The paper considers the exact powers of some of the new statistics recently developed by Iyer and Singh for certain cases of small samples and for two types of alternatives, namely, (i) having at least one run of one kind of a given length or more, and (ii) rectangular. These investigations show that the new statistics are more powerful than the Mann and Whitney or Wilcoxon's test.

The paper also considers the applications of a few of these statistics to particular situations.

11. *A χ-Approximation to Gini's Mean Difference. T. A. Ramasubhan, Indian Council of Agricultural Research, New Delhi.*

Using the absolute moments of the normal distribution obtained by Nabeya and Kamat, the latter has derived by a simpler approach, the variance and the third moment of Gini's Mean Difference 'g'. This paper evaluates the fourth moment of 'g' by making use of the results obtained by Kamat. The coefficients β_1 and β_2 are found to be in close agreement with the corresponding coefficients for the χ-distribution having the same coefficient of variation as that of 'g'. The results confirm Kamat's conjecture that the distribution of 'g' may be quite close to that of χ.

12. *The Distribution of Quasi-Ranges in Samples from a Non-Normal Population. S. K. Banerjee, Indian Council of Agricultural Research, New Delhi.*

This paper gives the distribution of quasi-ranges in samples drawn from any non-normal population represented by Gram-Charlier series.

The asymptotic distribution has also been obtained. In particular an attempt has been made to investigate the efficiency of the range as an estimate of the Standard Deviation. The efficiency has been calculated for different non-normal populations and for different sample sizes. It is found that for small samples and for populations not deviating too much from normality, range may be used as an efficient estimate of the standard deviation.

13. *Tables for a Non-parametric Two-sample Test suggested by Wolfowitz. N. C. Giri, Indian Council of Agricultural Research, New Delhi.*

Extending the principle of likelihood ratio criterion to test the null hypothesis that two stochastic variates X and Y have the same unknown cumulative distribution function, Wolfowitz derived a non-parametric test based on the number of runs of different lengths and showed that the test-statistic is asymptotically normally distributed. This point has been examined further and it has been shown that if n_1 and n_2 are the two sample sizes, then for $n_1 + n_2 \geqslant 16$ and min. $(n_1, n_2) \geqslant 5$, the distribution of the test statistic may be considered to be normal. This paper also investigates the small sample distribution of the test statistic and exact tables for testing the significance of two samples have been provided for min. $(n_1, n_2) \geqslant 4$ for various levels of significance.