ABSTRACT OF PAPERS PRESENTED AT THE 15TH ANNUAL GENERAL MEETING HELD AT CHANDIGARH IN DECEMBER 1961

1. *Effect on Maize Yield by Different Methods of Processing the Produce.* *P. S. Sahota and D. S. Choudhary, Chandigarh.*

Different methods are adopted by the cultivators for processing the produce of various crops. For example in case of maize crop, the cultivators after harvesting the crop keep the crop in stacks called moharas for about 2–4 weeks before the produce is thrashed. The cultivators are of view that during this period unripe cobs get a chance to ripen further and the grains lose their excessive moisture. Cobs are then separated from the plants and spread out in the sun to dry up. The grain is then separated from the cobs by beating with sticks. It may be added here that maize crop, unlike wheat, barley, etc., is not harvested dead ripe. The cultivators generally harvest the crop when the moisture content in the grain is between 30 and 40%.

The procedure adopted in crop cutting experiments is that the cobs are removed on the date of harvesting and are weighed without removing the sheaths on the same day. The cobs are exposed daily to the sun for two to three weeks till the cobs are fairly dried. At the end of this period the grains from the cobs are separated. The grain obtained is kept for 10 days for driage.

An experiment to study the effect of yield rate of maize due to these methods of processing was planned during the Khariff 1961–62. The experiments was laid out with two methods of harvesting that is:

(i) Removing the cobs on the date of harvesting, and

(ii) Keeping the harvesting crop in stacks for 2–3 weeks.

Both the methods were tried for thrashing at two intervals, *viz.*, thrashing after two weeks and thrashing after three weeks. Therefore, to investigate two factors at two levels simultaneously 22 factorial design was adopted. In all 40 plots in ten blocks were got harvested and analysed. The main factors, *i.e.*, the methods of harvesting, thrashing and interaction between them were found to be non-significant.

2. *The Growth of Agricultural Labour Force and Some of Its Effects on Agricultural Production in the Long Run.* *N. S. Shanthamma, Mysore.*

The purpose of this paper has been to examine the effect of growth of labour force on agricultural production in India. For this purpose the growth of Agricultural Labour Force in India has been estimated up to 1996, using alternative assumptions of population growth.

And also, using the relation $y_t = y_0 (1 + \cdot 064)^t$ and $y_t = My_0 - r_0 p_0 u$, the index of agricultural production has been estimated up to the year 1996.

The estimates show that the index of agricultural production will decline, with a constant M, unless there are changes in the technological field in agriculture. The decline in the index of agricultural production per unit of labour input is faster in the case, when an increase in fertility between 1956 and 1961 has been assumed.

The estimates depend on the fulfilment of the underlying assumptions, and cannot be taken as exact predictions.

The estimates show that unless the growth of population is checked effectively, there is a possibility of Malthusian conditions returning.

3. *Soil Classification, Valuation and Standardisation of Land.* *B. R. Kalra, New Delhi.*

Various methods and principles of soil classification, valuation and standardisation of agricultural lands have been employed from time to time in different States for purposes of land assessment, consolidation of holdings, tenancy and ceiling legislation, etc. Differences in soil, topography, land tenure system, pattern of crop and land utilization, etc., have been some of the determining factors. Even within a State, the technique has been changing with change in the abovementioned factors as well as the purpose in view.

While in some States like Madras and Uttar Pradesh, the classification of soil at the time of settlement was made with the object of basing the assessment on the net produce or rental income from different classes of land, in others like Bombay, the classification served as a basis for the apportionment of the total revenue demand, determined for a particular area on general considerations, among individual survey numbers of different soil characters. Generally, the soil classification at the time of settlement has been used as a working basis for all agrarian reforms such as consolidation of holdings, imposition of ceiling on landholdings, etc.

At the time of consolidation of holdings, the lands of different classes are exchanged on the basis of the productive value in Punjab and Madhya Pradesh, rental value in Uttar Pradesh and market value in Bombay. For the first time, a standard value of land was determined in Punjab in terms of annas on the basis of productivity of land for the settlement of displaced persons from Pakistan. The ceiling legislation in most of the States provides for the level of ceiling in terms of standard acres. The relative value of land is standardised in each State on the basis of the prescribed criteria such as soil and land characteristics, productivity, assessment and rent rates, etc., the underlying idea being to leave a uniform level of net income or value of land with the landholder. From the results of Census of Landholdings and Cultivation conducted in 1954, a number of State Governments published data on size and distribution of holdings in terms of standard acres.

The compensation payable to landholders under land reform measures in the form of multiples of net annual income or rental income or assessment rates reflects not only the value of land transferred but also the nature of rights abolished. Social considerations operate in not only keeping the quantum of compensation much below the market value but also in devising different rates of compensation for the same type of land held by big and small owners.

The main objective of betterment levy being to share an increase in the capital value of land arising from the execution of irrigation projects, the increase is generally estimated on the basis of prescribed multiples of additional annual income from land.

Statistics on land and crop utilization, yield of principal crops, cost of cultivation, farm management, etc., are the basic tools employed in the classification, valuation and standardisation of land. Because of many improvements made in the collection of these statistics during recent years, these can be used increasingly and more usefully for serving the various purposes stated above. With diversification of agriculture and simplification of tenures, it may not be essential any longer to adopt entirely different techniques of soil classification, valuation and standardisation in different areas.

It may be desirable to formulate a standard soil classification in respect of different regions from purely agronomic point of view, that is, from the viewpoint of the capacity of land to yield under varying conditions of soil properties, climate, irrigation, fertilisation, etc. With the help of basic agricultural statistics, the relative valuation of different classes of land in each region may be standardised on the basis of some well-established criteria such as gross or net income. Once formulated, the standard classification and valuation may hold good for an appreciable period of time. Through experience, standard values can further be made comparable on inter-regional or inter-State basis. It is worth considering as to how far it is feasible and worthwhile to work out and publish areas statistics in terms of standard acres. Consolidation and publication of average sale or mortgage value of different classes of agricultural lands at regional or State level could serve a variety of purposes and could be used supplementary to the data on standardisation of land.

4. *Investigations on the Optimum Pre-experimental Period in Field Experimentation on Perennial Crops. P. T. Abraham and G. A. Kulkarni, Institute of Agricultural Research Statistics, New Delhi.*

In experiments on perennial crops which are subject to large inherent biological variations and where the experiment lasts for a long period, one of the important methods of increasing the efficiency of the experiment is the use of pre-experimental records of the yields or other co-related characters. The minimum number of seasons for which such pre-experimental records should be taken needs to be determined for different crops. The efficiency of utilisation of pre-experimental yields and the number of years for which these records are to be taken depend on the correlation between the yields of successive years. The correlations between any two years can be considered either to be equal or to vary with the number of intervening years. Of these, the latter assumption is more realistic. A plausible model for the yield X_t of any year is $X_t = Y_t + Z_t$ where Y_t is a simple Markov process with zero mean and Z_t is an independent variate and independent process with zero mean. In this case, the correlation (R_s) between the yields of two years separated by 's' intervening years will be $R_s = \alpha + \beta\rho_s{}^5$. The expression for the efficiency of varying number of pre-experimental and experimental periods has been derived on the basis of the above pattern of correlation. In order to derive the maximum efficiency from the use of pre-experimental yields the technique of multiple variance needs to be used. Additional information obtained by this procedure has also been studied.

The formulae indicated above were applied to data collected for a period of 20 years on yield of coconut in a garden with 183 trees. It was found that the pattern of correlation between the yields of different years followed closely the above model after removing the biennial swing. It was found that only one pre-experimental period consisting of two consecutive years is the optimum. This procedure increased the efficiency of the experiment by about 60%. The use of multiple covariance with more pre-experimental period did not add any appreciable increase in the efficiency of the experiment.

5. *Uniformity Trial Studies on Mango. K. C. Agrawal, Government Horticultural Research Institute, Saharanpur.*

Uniformity trial data were recorded in a mango garden during 1959 on 96 trees of Maldah variety at Hanbane Nursery, Saharanpur. The population studies for the various characters have been made and it has been observed that variation in yield and the volume is roughly of the same order. A contour map of the garden has been presented. Plots of 1, 2, 3, 4, 5 and 6 trees have been tried. It has been observed that the information per tree goes on decreasing with the corresponding increase in the size of the plot. For unguarded trees it was seen that there was a steep decrease in the values of coefficient of variability up to plots of size 4 trees but after that there is a rapid increase in this value. A study of guarded plots revealed that maximum information is obtained from plots of three trees. For single tree plots circumference of trunk has been observed to be the better concomitant variate. A comparative study of the randomized block and latin square designs showed a relative efficiency of 93.05% for the former.

6. *Augmentation of Second-Order Response Surface Designs Through Non-Central Points. M. N. Das and B. S. Gill, I.A.R.S., New Delhi.*

In a response surface design denoting the levels of i-th factor by x_i it is known that a second-order rotatable design with N points can be obtained by including in the design the points which satisfy the relations.

$$\Sigma x_i^2 = N.$$

$$\Sigma x_i^4 = 3 \Sigma x_i^2 x_j^2, \text{ and}$$

$$\Sigma x_i^{a_i} x_j^{a_j} x_k^{a_k} x_l^{a_l} = 0$$

where at least one of the a's is odd and $\Sigma a_i < 5$.

Through the existing method of construction of such designs augmentation is possible only by adding central points. Following the method of construction of rotatable designs suggested by Das (1961) a method of augmentation of rotatable designs by adding non-central points has been made available. The designs obtained by augmenting through non-central points is more useful than those obtained by central points as the distribution of points is more even in this case.

Through such method of construction of designs by adding non-central points it is also possible to select a design with maximum precision from amongst those which are obtainable with the same number of points.

7. *An Experiment to Study the Effects of Processing the Produce on Yield Rates of Maize Crop. C. S. Grewal and Nitya Nand, Chandigarh.*

The methods of processing the experimental produce adopted in the Crop Estimation Surveys are at variance with those prevalent with the cultivators. There has been a strong belief that the survey results are under estimates of the actual yield rates. An experiment was designed to test whether the results obtained through the method recommended by State Statisticians and I.S.I. for crop estimation survey differ significantly from the corresponding estimates if obtained by the method of processing adopted by the cultivators.

A study was undertaken for this purpose on Maize during Khariff 1961–62.

An experiment in a Randomised Block Design with ten replications was planned in the farm of a progressive cultivator. The following five methods of processing which formed treatments were included for study.

1. Separating cobs from plants and unsheathing them for further processing (method adopted by I.S.I.).

2. Separating cobs from plants and storing with sheath (method adopted by State).

3. Retaining cobs on the plants and storing them in the middle of the heap called Mohara.

4. Retaining cobs on the plants and storing them on the periphery of the heap.

5. Same as in (4) but watering the heap.

8. *On the Problem of Estimation in Successive Two-Stage Sampling under Normality Assumption. B. D. Tikkiwal, Karnatak University, Dharwar.*

The general theory of successive two-stage sampling has been studied by the author (*Ann. Math. Stat.*, 1958, **29**, 1291). The best estimator of the population mean on the h-th occasion and its variance was obtained under the assumptions that the various correlation and regression coefficients occurring in the best estimator are known in advance. When the various correlation and regression coefficients are estimated from the sample, it is shown here that the various results can be derived as in the author's paper (*J. Ind. Soc. Agric. Stat.*, 1956, **8,** 84–90) under the following analysis of variance model. Let x_{ijk} denote an observation on k-th second-stage unit of j-th primary unit on i-th occasion. Let μ_i denote the population mean on i-th occasion. Let F_{ij} and S_{ijk} be the suitable normal random effects. Then $x_{ijk} = \mu_i + F_{ij} + S_{ijk}$ for all i, j, k.

9. *Construction of Second-Order Rotatable Designs through Partially Balanced Incomplete Block Designs. P. J. Thaker, I.A.R.S., New Delhi.*

The paper describes different methods of construction of second-order rotatable designs through two associates partially balanced incomplete block designs. In all two hundred and twenty-two second-order rotatable designs are derived up to $v = 12$ factors, starting with $v = 6$ factors. The minimum total number of points, contained in these designs as well as in designs obtained by other authors, are presented below for comparative study.

	$v = 9$	$v = 8$	$v \doteq 9$	$v = 10$	$v = 12$
Thaker (Through P.B.I.B. designs)	44	144	180	148	280
Das and Narsimham (Through B.I.B. designs)	44	144	194	196	728
Box and Hunter (Cube + Octahedron designs)	44	60	146	148	280

10. *On Designs Obtainable by Combining Different Designs.* S. S. Swaminathan, I.A.R.S., New Delhi.

In this paper a method of construction of incomplete block designs by combining two incomplete block designs has been described. The method in short is as follows. First an incomplete block design is taken and then with the treatments of each of the blocks, another incomplete block design has formed. The resultant design is another incomplete block design. If both the designs are balanced incomplete block designs the resultant design is also a balanced incomplete block design. If the first design is a balanced incomplete block design and the second a partially balanced incomplete block design with m associate classes and *vice versa* the resultant design is a partially balanced incomplete block design with the same number of associate classes as in the partially balanced incomplete block design used earlier.

Another method of combination of designs has been devised as follows. First let us take an incomplete block design with 'v' treatments and associate 'm' treatments with each of the v treatments so that there will be in all $m \times v$ treatments. The treatments within each block can always be arranged into m groups (of k treatments each, where k is the block size of the first design) corresponding to each of the m associated treatments. By forming another incomplete block design by treating these m groups as m treatments we shall be getting another incomplete block design. In particular if both the designs happen to be partially balanced incomplete block designs with n and s associate classes the resultant design will be a partially balanced incomplete block design with $(n + 1)(s + 1) - 1$ associate classes.

11. *Use of Factorial Designs in Large-scale Field Trials.* K. S. Krishnan, I.A.R.S., New Delhi.

Factorial designs—simple as well as confounded—are widely used in field experiments in Agricultural Research Stations. Use of these designs in trials on cultivators' fields has also become common now. While using these design techniques in large-scale field trials a few special problems arise regarding the selection of suitable designs and their analysis and interpretation. The considerations in the choice of designs for field trials have been dealt with in the Book *Statistical Methods for Agricultural Workers* by Panse and Sukhatme. Papers on suitable designs for the purpose have been published by a number of authors. In most of them the need for keeping the number of factors and levels as few as possible has been stressed from the point of view of field convenience. From the viewpoint of efficiency also it can be shown that increasing the number of factors or levels is not desirable.

In the analysis and interpretation of the result of factorial experiments it is commonly assumed that the experimental error for different treatment contrasts are the same. That this is not so for large-scale field trials is illustrated with experimental data. A further precaution necessary in the analysis of these data is the need for taking into consideration the input costs corresponding to the levels of different factors. This and alternative interpretations of interaction effects are discussed. The rôle of nominated degree of freedom is indicated.

12. *Some Results in Asymmetrical Factorial Designs. P. R. Sreenath, I.A.R.S., New Delhi.*

1. Das (1960) obtained Asymmetrical Factorial Designs as fractional replicates of Symmetrical Factorial Designs. But he did not include any investigation regarding the loss of information of affected Interactions. From an investigation of this problem it has been shown that:

In the design $q \times s^n$ in $q \times s^k$ plot blocks, where $s^{r-1} < q < s^r$ and s a prime number and s and q have no common factor:

(i) the loss of information of the affected interaction containing real factors only is equal to

$$\frac{\text{Number of treatment combinations omitted}}{q\,(s^r - 1)}$$

(ii) the loss of information of the affected mixed interaction is equal to:

$$\frac{1}{q-1}\left\{1 - \frac{\text{Number of treatment combinations omitted}}{q\,(s^r - 1)}\right\}.$$

2. Shah (1960) gave a method of construction of B.F.E. by the combination of (i) an asymmetrical design and (ii) a symmetrical factorial design. But he did not indicate the interactions that are affected as also their loss of information. This problem has been solved completely as indicated below.

We call the Asymmetrical Design used to obtained the B.F.E. as the Primary design and the Symmetrical design used as the Secondary design. We call the set of interactions that are confounded while obtaining the secondary design as the between block set. For the sake of association we subdivide the block of the secondary design into sub-blocks by confounding other interactions which we call as the within block set of confounded Interactions.

The interactions that are affected in the B.F.E. are: (i) the interactions between real factors that are affected in the primary design; (ii) the between block set of interactions; (iii) Interactions between (i) and (ii); (iv) Interactions between (i) and the within block set of interactions.

Denoting by x the loss of information on the Interaction between the real factors only in the primary design and by y the loss of information on the mixed interaction in the primary design, the loss of information design on each of (i) and (iii) is x and on (iv) it is y, the interactions in (ii) being completely confounded.

3. Das (1960) has given a method of construction of Balanced Asymmetrical Factorial Designs ($q \times 2^2$, 2) through B.I.B. design. The same method has been used for obtaining Partially Balanced Asymmetrical Factorial Designs of the type ($q \times 2^2$, 2).

In these designs when q is odd, the real factor interaction loses the same amount of information as in the design obtained by B.I.B. design.

13. *Partially Balanced Asymmetrical Factorial Designs. K. Kishen, Chief Statistician to Government, Department of Agriculture, U.P., Lucknow and B. N. Tyagi, Statistician, Department of Agriculture, U.P., Lucknow.*

If in an equi-replicated and equi-block partially confounded factorial design, the loss of information on each of the unitary components of d degrees of freedom belonging to a partially confounded effect, F_3, is equal to, say, M, the design is said to be completely balanced. When, however, in such a design, the loss of information on each of the single degrees of freedom belonging to a partially confounded effect is unequal, the design is called partially balanced. It has been shown that by use of appropriately chosen P.B.I.B. designs, partially balanced asymmetrical factorial designs can be constructed. For the 6×2^2, 10×2^2, 12×2^2, 14×2^2, 18×2^2 and 20×2^2 designs, optimum partially balanced asymmetrical factorial designs in 4, 8, 6, 8, 10 and 6 blocks of 12, 20, 24, 28, 36 and 40 plots each respectively have been obtained by use of this method in which BC is unconfounded. For the 9×2^2, 15×2^2 and 21×2^2 partially balanced designs in 6, 6 and 14 blocks of 18, 30 and 42 plots each respectively have been constructed in which the loss of information on BC is 1/9, 1/9 and 1/49 respectively as against 1/81, 1/225 and 11/44 if the designs were optimum. These partially balanced designs are likely to be of considerable practical utility as these result in a marked diminution in the number of replications required for complete balance.

14. *A Note on Direction and Collinearity Factors in Canonical Analysis. Dr. A. M. Kshirsagar, Bombay.*

In the problem of testing the goodness of fit of a single discriminant function for discriminating between *several* groups, one is required to consider the two aspects of the hypothetical discriminant function, *viz.*, (i) whether one discriminant function can be adequate for this task and (ii) whether the direction of the hypothetical function coincides with that of the true one. Bartlett has derived (i) collinearity and (ii) direction factors for testing these two aspects. There is a close analogy between discriminant analysis and regression analysis. Thus, if there are p variates under consideration and $q+1$ groups, the relevant discriminant functions are the canonical variates in the canonical analysis of the p variates with q "dummy" variables representing the degrees of freedom corresponding to "Between groups" sum of squares and products. The tests Bartlett derived pertained to the situation when the hypothetical discriminant function is given in the space of the p variables. But there are situations when the hypothetical discriminant function is given in the space of the "dummy" variables. The direction and collinearity factors are derived for this situation and the procedure is illustrated by application to Barnard's Egyptial Skulls data.

15. *Three Sample Non-Parametric Test. M. V. Deshpande, I.A.R.S., New Delhi.*

An optimum Two Sample Non-Parametric Test for a given type of alternative has been derived by Lehmann (1953). This test differed from that of Wilcoxon's two-sided rank test in having two additional terms. The proposed test had been already studied in detail and compared with Wilcoxon's test. On the basis of these results obtained it was felt necessary to extend the same test for three samples. The present paper deals with some properties of three sample tests. The recurrence relation is obtained for the same test and using this the moments of the proposed test are worked out. The limiting distribution under the null hypothesis is derived.

16. *Estimation of Genetic Correlation Coefficient from Half-Sib and Full-Sib Analysis and Its Standard Error.* *G. A. Kulkarni and N. C. Khandekar, I.A.R.S., New Delhi.*

Estimation of the precision of genetic correlation coefficient has received considerable attention in recent years. Robertson (1959) and Tallis (1959) have worked out the standard error in case of half-sib analysis with equal number of offspring per sire. These results are usually not applicable in practice since the number of offspring per sire is hardly the same.

The present paper deals with the cases of half-sib and full-sib analyses with unbalanced classification. The expressions for standard errors have been worked out and illustrated with examples.

The matrix method developed by Seare (1956, 1958) to obtain variances of variance components has been extended to work out the covariance between mean sum of squares and mean sum of products as also between the two mean squares for the same source to derive the expression for standard error of the genetic correlation coefficient in the two cases. The method is outlined in the appendix.

17. *On Stability of Estimates of Variances in Simple Random Sampling Procedures and in Ratio Methods of Estimation.* *A. R. Kokan, I.A.R.S., New Delhi.*

Ratio methods of estimation are invariably preferred to methods of estimation by simple random sampling procedures whenever the estimation variable (y) is highly correlated with an auxiliary variable (x) whose total X for the population is known, the regression line passes through the origin and when $P > C_x/2C_y$, where P is the correlation between x and y and C_x and C_y are their coefficients of variation. If y' and y'' are estimates of Y, the population total under investigation, based on simple random sample procedure and ratio method of estimation respectively, then it is shown that $s_{y'}$ and $s_{y''}$, which are the estimates of the standard errors of y' and y'', are not equally stable where the stability is judged by their coefficients of variation $C(s_{y'})$ and $C(s_{y''})$. It is also shown that for samples from bivariate normal distributions $C(s_{y''})$ is always larger than $C(s_{y'})$ and for samples from bivariate log normal distributions $C(s_{y''})$ exceeds $C(s_{y'})$ by high percentages for certain ranges of C_y/C_x and C_x. In one numerical example also $C(s_{y''})$ is considerably larger than $C(s_{y'})$. Certain other comparisons are also made. Hence, some caution is necessary before one attempts to use ratio methods of estimation in preference to methods of estimation by simple random sampling procedures.

18. *A Study of Rainfall Data and Its Related Aspects in Gujarat State.* *P. S. Sharma.*

An attempt has been made here to work out the average rainfall and its coefficients of variation on the basis of observations for various taluks located in a district for the years 1957, 1958 and 1959. It is observed that the variability in relation to the level of average rainfall was relatively more in 1957 and 1958 as compared to 1959.

The average rainfall figures have been weighted by applying the geographical area of a tehsil as weight. On the basis of weighted rainfall data, the coefficients of variation have been calculated. It has been found that the weightage factor does not influence the level of variability arrived at on the basis of simple average rainfall figures. It is further observed that some of the districts show relatively high variability in rainfall. This is a disturbing feature for the planner and the analyst dealing with the forecast of agricultural production and the fixation of targets of crops.

It is also observed that districts with a relatively lower level of rainfall have a higher level of area irrigated in relation to net area sown. Most of the districts in Gujarat have a low level of area irrigated. But still Gujarat is famous for cotton which is an important irrigated crop.

The low level of rainfall in many districts of Gujarat has to be consideraed in relation to the type of soil prevalent there. In Gujarat black and alluvial soils are mostly prevalent. The black soil is famous for its high clay content and high water-holding capacity. The capacity for moisture absorption of the soil might help to some extent in the regulation of water-supply for various crops. Perhaps this situation might partly explain the cultivation of irrigated crops like cotton with the help of rainfall in Gujarat. Further the growth of cotton, which has relatively long duration as compared to cereal crops, tends to reduce the intensity of cropping in various districts of Gujarat. Lastly, the various districts have been grouped on the basis of main and subsidiary crops. On this basis, it is possible to form specific crop belts relating to cotton, cotton-millets, millets, and millet-groundnut. On the whole, Gujarat State comes under cotton-millets-groundnut zone on the basis of crops.

19. *Selection between Lines in a Mixed Population.* *S. N. Sen, Department of Agriculture Patna.*

In any system of inbreeding, the population divides into a number of lines. Any amount of selection 'between lines' reduces the proportion of the homozygosity in the successive generations and ultimately leads to the complete heterozygosity. In the mixed population where both selfing and natural crossing are present in varying proportions, the rate of disappearance of the homozygosity at successive generations will be at a higher rate than in case of purely self-fertilized population. Selection within lines have been studied earlier in case of mixed population (Sen, 1961). Different other cases of selection procedure arising in such mixed population have been studied earlier in details (Sen, 1958 and 1960).

In the early states of the breeding programmes, the heterozygous lines seggregate and some homozygous lines are discarded in each generation. Selection between lines in the mixed population where the heterozygous lines are somewhat superior to homozygous lines with respect to an economically desired character are discussed here. Different cases where the measures of selection for two homozygous lines are either equal or unequal have been studied. If the homozygosis is having sought, then the programme of inbreeding should be as close as possible.

20. *On the Composition of Two Means from Normal Populations with Unknown Variances. M. B. Golhar, I.A.R.S., New Delhi.*

Solutions to the problem of comparison of two means from normal populations with unknown (possibly unequal) variances are given by Fisher (1935), Scheffe (1943) and Welch (1947). Fisher's approach based on fiducial distribution is criticised for the fact that probability of rejecting the hypothesis, when true, is less than the nominal value, say ·05.

In this paper two methods given by Welch and Scheffe are compared by finding their respective powers. Tables for the second kind of error for t tests are given by Neyman (1935) which will be useful for finding power in Scheffe's test. Second kind of error for Welch's test has been calculated in this paper and it shows that these two tests give approximately same power.

Wald's posthumously published paper also gives the solution for this problem in the particular case when sample sizes are equal. It has been shown in this paper that Wald's solution though better than Fisher's lacks sensitivity in comparison with Welch's solution.

21. *Testing for Equality of Treatment Means in a R.B.D. Trial with Heterogenous Error Variances. V. Behari, I.A.R.S., New Delhi.*

Testing for the Equality of Treatment means in the case of a R.B.D. when the error variance of the observations differ from one treatment to another has been considered by Graybill (1954). He used the Hotelling's T^2 for test of the hypothesis of zero means in a multivariate distribution. Intuitively, this method would not be an efficient method when the correlations are known to be zero. Moreover, the Hotelling's T^2 test can be applied in a more general way than by Graybill (*cf.*, Rao, 1952). In this paper these tests have been compared to one based on the theory of linear estimation of parameters in the case of unequal variances by Ghosh (1961). It has been shown that the latter is more powerful in the sense that the test is made with larger number of degrees of freedom and in both cases the F-distribution is used.