

ABSTRACTS OF PAPERS PRESENTED AT THE 21ST ANNUAL GENERAL MEETING HELD AT LUCKNOW IN FEBRUARY, 1968

1. *Support Price and Resource Allocation Determinant Models.*

By D. Ramesh, Agricultural Prices Commission, New Delhi.

Among the risks and uncertainties to be reckoned with while taking managerial decisions on additional investment in improved farm technology, price uncertainty is one of the more important factors. Price support in the form of guaranteed minimum prices is the most ubiquitous and effective. Supply price determinant models have also the same constraints as models developed to generate 'equilibrium' or 'pivot' prices.

2. Two models have been discussed. The first model starts with the premise that the farmer producer should be assured, after additional investment, at least the net income he got from the traditional farming and cover the additional cost of improved technology. Thereafter suitable allowances are made for risk and uncertainty. By varying this margin, different levels of incentive prices are generated.

3. The second model relates to optimal investment and the directions of additional cost. Assuming mobility of the factors of production and availability of credit, this model examines the level of price which would generate a pre-determined level of output and covers the marginal cost and an assumed margin for risk and uncertainty, and the optimal level of total investment for achieving this output. Having determined the optimum level of investment, the model also examines the directions in which the additional investment should flow.

4. The empirical exercise for the first model is based on the Demonstration data for I.A.D.P. and gives estimated incentive prices at four levels of margin for paddy, wheat, jowar, gram, ragi and jute for some states.

The empirical exercises for Model II relate to the Demonstration Data of I.A.D.P. for Madras (Thanjavur District). The optimum level of investment per acre of paddy has been estimated. The specific inputs, which this additional investment may be directed to, have been indicated.

2. *A review of techniques of analysis of uniformity trial for optimising plot geometries and some practical problems in horticultural trials.* By Vinod Behari, Punjab Agricultural University, Ludhiana.

The review points out some of the areas for further research in the statistical methodology relating to the analysis of uniformity data for the purpose of plot technique. It also outlines some of the practical problems peculiar to horticultural trials.

3. *Disparity in Agricultural Income per Worker per capita.* By D.S. Mehra and S.K. Aggarwal, Agricultural Prices Commission, New Delhi.

An attempt has been made in this paper to illustrate the disparity in agricultural income per cultivator, per agricultural worker, per cultivating household and per capita of the cultivating population. Unlike the general practice, we have taken into account the principal as well as secondary work as cultivator and agricultural labourer with a view to working out a range within which the income of a cultivator or agricultural worker could vary. We have estimated gross and net value of output for all agricultural crops, cultivating population and cultivators and agricultural labourers (on the basis of principal and secondary work). We have prepared two estimates of value of output which include and exclude plantation crops, fruits and vegetables, drugs and narcotics, condiments and spices, grass etc. The underlying idea is that workers principally engaged in growing plantations crops etc. are not included in cultivators. The two estimates give the two limits of net value of output. We have dealt with the complications involved in the estimation of income per worker.

It is observed that the proportion of income originating from agriculture is much lower than the proportion of workers/population it has to sustain. There exists wide disparity at the State level. Gujarat, Kerala, Madras, Maharashtra, Punjab and West Bengal share much more in the receipts from agriculture than their respective contributions in population, cultivating households, cultivators

and agricultural labourers. Uttar Pradesh, Bihar and Rajasthan are at the other extreme. The average net return per cultivator (on the basis of principal work only) comes to about Rs. 2.00 per day for all States taken together as against Rs. 4.00 for workers principally engaged in non-agricultural sector. If secondary work as cultivator is also accounted for the average income per cultivator ranges between Rs. 1.54 to Rs. 2.10. If wage payments are also allowed for the lower limit is further reduced to Rs. 1.17 per day. This shows that the retained net return of the cultivator is no better than the agricultural wages per day.

If the dependents of cultivators (by principal or secondary work) are also considered, the average per capita income for all States comes to 63 paise when all crops are included and 52 paise where plantation crops etc. are excluded. The level of consumer expenditure per day being Re. 0.71, agricultural income per capita does not suffice for meeting even consumer expenditure. The situation, among other things, demands greater attention in bringing about considerable shift in the working population dependent on agriculture as the decade 1951-61 only recorded about 2 per cent reduction in male dependence on agriculture.

4. *Critical Review of the Assessment of Soil Conservation Measures in India.* By R. V. Tamhane, H. T. Khemchandani and G. A. Kulkarni, Deptt. of Agriculture, Krishi Bhavan, New Delhi.

The paper briefly summarises the results of evaluation of soil conservation programme (contour bunding, terracing and dry farming practices) carried out in the States of Maharashtra, Madras, Punjab and Uttar Pradesh and also the work of Programme Evaluation Organisation. The increase in crop yield on account of contour bunding and terracing varied considerably for different crops and for different States. The range was from 14 to about 36 per cent. The data from Maharashtra also indicated that on account of contour bunding programme, the area under cultivation increased from 1 to 4 per cent in different years, the area under fallow contracted and the area under minor crops also showed a shift for decrease giving place to more paying crops. Besides, there was increase in the water table of wells by about 2.5 ft. also

Evaluation studies so far carried out are rather meagre in extent and inadequate in details. Information is available only in

regard to general increase in crop yield on account of soil conservation measures. In view of the increasing national investments that will be made on soil conservation programme in the future, it is necessary to have a more critical evaluation of it in all States covering various aspects of soil, climate, time factor and also the direct and indirect benefits, including the cost/benefit ratios. Such an assessment would firstly help in providing fitting answers to the farmers' queries as to the cost involved and the long and short term benefits accrued. Secondly from the national stand-point it will help to provide the sound criteria and standards for making future national investments, securing institutional loans through Agricultural Refinance Corporation and banks and also assessing the production potential. Accordingly, a scheme for evaluation of soil conservation measures has been formulated.

5. *Assessment of the relative contribution of factors leading to decline of Sugarcane area in Uttar Pradesh during 1966-67* By Y.N. Bali, Lucknow.

The sugar production in the country declined steeply to 21.43 lakh tonnes in 1966-67 from 35.32 lakh tonnes in 1965-66. In Uttar Pradesh, accounting for 35 to 40 per cent of country's sugar production, the sugarcane area went down to 29.82 lakh acres during 1966-67 from 36.81 lakh acres in 1965-66. The two dominant factors contributing to the fall of sugarcane area in the state are drought and disparity of sugarcane prices vis-a-vis other agricultural crops. It has been explained in this paper that disparity of prices is the more predominant of the two factors for reducing the sugarcane area. The effect of price disparity on the fall of sugarcane area has been shown to be more pronounced in non-factory areas than factory areas.

6. *Trends in Agricultural Production.* By G.K. Mathur and S.K. Aggarwal, Central Statistical Organisation, New Delhi.

During the three Five Year Plans of economic and social development of the country there has been steady investment in dams, irrigation projects and various other development programmes for the improvement of agricultural production and this has effected the growth of agriculture sector. The fact that agriculture depends on several unpredictable factors such as weather conditions, relative prices of different crops etc., it is difficult to establish any precise relationship between levels of agricultural production and the extent

of benefits accrued from development programmes from year to year. But the production potential created by these programmes is reflected in high production in a year of favourable weather conditions and it would be more appropriate to study trends over a longer period before firm conclusions regarding growth rate could be established. The present study, therefore, concerns with a proper assessment of the growth of agricultural production for all India as well as for States over the period of the three Five Year Plans, 1950-51 to 1965-66. The net product from agriculture, on the basis of which the trends have been studied, covers all principal and minor crops and various by-products of economic importance. Supplemented by data on gross area sown, the trends in net product per hectare have also been examined. An attempt has also been made to examine the relationship between net product and two important items of input namely irrigation, fertilizer with gross area sown taking into account only those years which are normal and omitting abnormal years from the analysis. A multiple regression has been fitted by taking into account net product as a dependent variable and fertilizer distributed, gross area sown and gross area irrigated as three independent variables. The multiple correlation coefficient works out to be highly significant showing thereby that there is a good relationship between the net product and irrigation, fertilizer and gross area sown. Such relationships are of considerable value in forecasting net product from agriculture in a year of good agricultural season.

7. *Area Under Mixed Crops.* By R.P. Saha and S.B. Pillai, Indian Statistical Institute, Calcutta.

SUMMARY. This paper discusses the various methods of allocation of area under mixed crops followed in India for obtaining crop area statistics published by the Central Ministry of Food and Agriculture, and in some African and Latin American countries where also mixed cropping is widely practised. The limitations of these procedures are also discussed. A simple method, free from the limitation inherent in various methods of allocation, has been suggested for recording area under mixed crops. The procedure suggested consists of recording area under each of the mixed crops with the names of constituent crops. Introduction of this procedure would necessitate some changes in the compilation and presentation of crop area and land use statistics and these have also been briefly indicated.

8. *Partial Diallel Crosses and Incomplete Block Designs.* By M.N. Das and K. Sivaram, I.A.R.S. (ICAR), New Delhi.

As the number of inbred lines increases, the number of crosses to be performed in a full diallel becomes very large. As with limited facilities it is not always possible to handle larger number of lines in an investigation, it is necessary to evolve suitable plans for partial diallel crosses. In the present investigation we have provided an use of P.B.I.B. designs with any block-size and any number of associate classes and replications for generating suitable plans for partial diallel crosses together with a straight-forward method of analysis of these plans. With examples illustrating the technique of obtaining such sample of crosses, the variance for comparing any two lines are obtained. The present approach seems more advantageous in providing manageable samples for larger numbers of parental lines.

9. *5-Levelled Response Surface Designs with Equispaced Levels.* By A. Dey and M.N. Das, I.A.R.S. (I.C.A.R.), New Delhi.

Mainly four series of second order rotatable designs are available, viz., (i) central composite designs, (ii) those obtainable by using B.I.B. designs with $r=3\lambda$, (iii) those obtainable through B.I.B. designs with $r < 3\lambda$ and (iv) those obtainable through B.I.B. designs with $r > 3\lambda$.

All these designs excepting those under category (ii) have 5-levels, the middle three of which are equispaced but not the extreme ones. Corresponding to each of the above series of second order rotatable designs another series of design has been obtained simply by changing the extreme doses so as to make all the 5-doses equispaced and keeping all other things the same as in the rotatable design. The design obtained from the first of the series comes out as a particular case of Box and Wilson's (1951) "Composite Designs". The efficiency of these designs derived from the rotatable designs has been obtained against the corresponding rotatable design. It is found in general that the derived designs estimate the response more precisely at the central region.

10. "On the Optimum Size and Shape of plots for Sugarcane Field Experiments." By K.C. Agrawal & K.N. Kaushal, Sugarcane Research Station, Shahjahanpur.

A uniformity trial on sugarcane was started at the Sugarcane Research Station, Shahjahanpur, during the year 1943-44 on an area of 1.45 acres.

The results of the 1st six crops of sugarcane harvested in 1440 small plots of $12' \times 3'$ each have been discussed.

It has been observed that the coefficient of variation decreased on the increase of plot size either in length or in breadth but the decrease was more rapid in the case of increased length.

For larger plot size the shape of plots plays an important role in sugarcane field experiments and if the longer dimension of the plots is kept along the direction of the rows more precise results are obtained.

The plots of 12/1210 acres in the shape of $24' \times 18'$ and $36' \times 12'$ have been recommended for irrigated sugarcane field experiments in U.P. for guarded and unguarded plots respectively on the basis of various theoretical and practical considerations.

For sugarcane field experiments 6 to 8 replications have been found satisfactory provided the number of treatments tried is not less than 6.

11. "*Designs for Paired & Triad Comparisons*". By G. Sadasivan, I.A.R.I., New Delhi.

If there be m objects x_1, x_2, \dots, x_m to be ranked according to some character or characters any comparison of the type x_i, x_j is called a paired comparison and any comparison involving three objects x_i, x_j, x_k (i, j and k all distinct) is called a triad. In this paper the author discusses the different possible designs that can be used for making such comparisons. If all the $\frac{m(m-1)}{2}$ pairs are compared with equal frequency, the designs would be simple. But in sensory testing when m is large, the number of comparisons would be large. It would be more so in the case of triads. To overcome this difficulty practical pairs and fractional triads are introduced. The author discusses here the methods of formation of these and also the designs suitable for such triads. How the combinational analysis is modified in such situation is also discussed. Brief mention is also made about modification required in the Bradley Theory Model and Thurstone-Mosteller Model of the analysis in such situations.

12. "Group-Divisible Rotatable Designs—Some Further Considerations". By A. Dey, I.A.R.S., New Delhi and A.K. Nigam, B.H.U., Varanasi.

Group Divisible Rotatable Designs were introduced by Das and Dey (1967). They presented a series of response surface designs in which the v-factors of the design can be split into two groups, one containing the p-factors and the other the rest (v-p) factors ; the design is rotatable within each of the groups when the level of the factors in the other group are held constant. Thus, when a second degree surface is fitted through this design, the variance of the estimated response is a function of two distances, d_1^2 and d_2^2 .

The above mentioned authors have discussed the method of construction of these designs in detail. The designs presented by them were all 5-level designs. The present paper aims at reducing the number of points required for the designs with 5-levels and also obtaining some designs with factors each at 3-levels.

13. *On Investigation of Isomorphism of Different Solutions of the B.I.B. Design (31, 31, 15, 15, 7)*. By A.C. Kulshreshtha and D.K. Joshi, I.A.R.S., New Delhi.

For the B.I.B. design (31, 31, 15, 15, 7) the following solutions ;

(A) (0, 1, 2, 3, 5, 6, 8, 11, 12, 18, 19, 20, 23, 27, 29) through the cyclic solution to P.G. (4,2) : 3,

(B) (1, 2, 4, 5, 7, 8, 9, 10, 14, 16, 18, 19, 20, 25, 28) due to Bose (1939), and

(C) (1, 2, 3, 4, 6, 8, 12, 15, 16, 17, 23, 24, 27, 29, 30) due to Marshal Hall (1958),

were considered by Rao (1961) and he established that the last two solutions are non-isomorphic. The relationship of the solutions to the first solution was, however, not investigated. In the present paper we have investigated the relationship of these solutions by the method of standardization as given by Das and Kulshreshtha (1967). It is found that the solutions A and C are non-isomorphic with the permutation, $P=4-2^n Q, \text{ mod } (31)$, where P denotes varietal numbers in solution A, Q denotes varietal numbers in solution B, and n is any integer. The solutions A and B are non-isomorphic. Further, there are only two distinct isomorphic initial blocks for the series with $v=4\lambda+3$ and $K=2\lambda+1$, obtainable by Bose's method.

14. "*On analysis of confounded factorial experiments.*" By R.C. Jain and M.N. Das, I.A.R.S. (I.C.A.R.), New Delhi.

When a confounded factorial design is constructed by adopting finite geometry in Galois fields, it is difficult to get adjusted (for block effects) linear, quadratic etc. components of those interactions some of whose components are confounded. We have given a theorem for linking two different complete sets of mutually orthogonal contrasts out of the same data and by virtue of this theorem such adjusted component can be obtained. Moreover this theorem seems to be of great importance as it can be used for solving a problem by using a design meant for some other problem.

15. "*Construction of P.B.I.B. Designs through the confounded designs of 2^n factorials.*" By G.M. Saha, I.A.R.S., New Delhi.

After the partially balanced incomplete block (p.b.i.b) designs were introduced by Bose and Fair (1939), a good number of persons have put forward methods of construction of two- and more-associate designs. Shah (1959) gave a method of construction of three-associate designs. Recently, Adhikari gave a method of construction of m-associate designs.

In the present paper, an attempt has been made to construct p.b.i.b. designs of two and more associates by using confounded 2^n factorials.

Earlier confounded designs of 2^n factorials gave us some series of p.b.i.b. designs. Now, the block contents of those confounded designs have been considered, and are seen to give new series of designs.

Also, interactions of any given even number of factors have been considered in the present paper.

16. *On Construction of Confounded asymmetrical factorial design in general.* By A.K. Banerjee and M.N. Das, I.A.R.S. (I.C.A.R.), New Delhi.

Existing methods of construction of confounded designs for asymmetrical factorial experiments involving any type of levels are not very satisfactory in the sense that in many cases suitable designs with reasonable number of replications are not available. For example, if there be an experiment involving two factors at 5 and 7 levels, no design with 2 or 3 replications seems possible through the existing method of construction. Thus it seems there is a need to

exploit other methods for a more satisfactory solution of the problem. An attempt has been made to solve this problem by linking the symmetrical designs with suitable corresponding symmetrical designs.

17. *Asymmetrical factorial designs in two replications*. By A.C. Kulshreshtha, I.A.R.S. (I.C.A.R.), New Delhi.

Binet, et al (1955) considered analysis of factorial experiments in single replications. These authors considered higher degree interaction components as the source of error and adjusted the affected interaction components. It seems that these authors were not aware of the important property of independence of different affected interaction components (in asymmetrical designs) among themselves. In the present paper this property has been taken into consideration and it has been shown that the error can be obtained with the minimum of two replications. Adjustments of the block effects have been made using a two way table and some properties of this table have been noticed. A few illustrations have been given for confounded asymmetrical designs in two replications. These two replications are taken from the totality of replications necessary for a balanced confounding and obtained by the available conventional method.

18. *"Analysis of a series of Fertilizer Trials in Cultivators' Fields"*. By N. Ramadurai and B.S. Gill, I.A.R.S. (I.C.A.R.), New Delhi.

In the present investigation some designs for conducting a series of fertilizer trials in cultivators' fields when the effects due to years are suspected to be present have been suggested. Procedure of statistical analysis of these designs have also been discussed. A problem in the analysis of these designs arises in view of the fact that the number of parameters to be estimated remain more than the number of linearly independent equations, even after the linear restrictions on the parameters are imposed. This problem has been solved by taking some parametric functions instead of the parameters. The sum of squares due to them have also been obtained after utilizing an orthogonalizing procedure. As an illustration data pertaining to a series of an experiment with three factors N, P, and K each at two levels, under the scheme of simple fertilizer trials I.C.A.R. have been analysed.

19. *"A Survey of Agricultural Experimentation in India"*. By T.P. Abraham, G.A. Kulkarni & M.L. Sahni, I.A.R.S. (I.C.A.R.), New Delhi.

Results of well-planned and scientifically conducted agricultural field experiments provide the basic data for making technical recommendations for increased agricultural production. A good deal of effort and large funds are being diverted for carrying out such field experiments at the research stations and in cultivators' fields. A critical review of the progress made in recent years in agricultural experimentation with special reference to extent of precision achieved in relation to the design of the experiments can be of great use in increasing efficiency of agricultural experiments. The object of the present paper is to make such a study based on the comprehensive data collected by the I.A.R.S. as part of the National Index of field Experiments programme.

Details of nearly 15 to 16 thousand field experiments conducted by the State and Central Research Institutes for the period 1948-59 available under the project were utilised for the study.

Besides the general discussion of the distribution of experiments according to the types of treatments tried and crops, the studies on the following topics are also made : (1) Structure of experiments covered, (2) Design of experiments adopted, (3) Amount of information on treatments by scoring technique, (4) Accuracy of experiments and minimum number of replications required for detecting 10% and 15% differences between treatments.

20. *The Influence of Meteorological Factors on the Yield of Paddy Crop.* By P.S. Sreenivasan, Poona.

Under the Co-ordinated Crop-Weather Scheme, paddy is under systematic observations among other places at Karjat in Maharashtra State, Chinsurah in West Bengal and Pattambi in Kerala. Adopting the special statistical technique developed by Fisher for examining the influence of rainfall on wheat yield at Rothamsted, the effects of rainfall and mean temperature distribution at these three stations have been evaluated. For Karjat alone, the effect of bright hours of sunshine was worked out. About 72% of variation in yield has been accounted for by rainfall during the cropping season in Pattambi whereas the rainfall could account for only 63% and 21% in Chinsurah and Karjat respectively.

In Pattambi and Chinsurah where the rainfall distribution has significant influence the response curves indicate that rainfall in the week of transplanting and elongation phase is detrimental to the crop whereas it is beneficial during the tillering, flowering and post-

flowering phases. The degree of response for a unit of rainfall are more than double in Chinsurah.

From a similar study it was found that the mean temperature accounts for 46%, 44% and 15% of total variation at Karjat, Chinsurah and Pattambi respectively. Also the response curves of Karjat and Chinsurah are very similar. Higher mean temperature at the time of transplantation and elongation is detrimental to the crop whereas it is beneficial during the tillering and ripening phases.

Due to paucity of data, response of crop to bright hours of sunshine could be worked out only for Karjat. The multiple correlation is of the order of 0.6834 while this is only 0.6808 for mean temperature and 0.4640 for rainfall in Karjat. Bright sunshine seems to be conducive at the early stages of tillering, and during panicle emergence and ripening phases. On the other hand, higher sunshine during elongation phase is detrimental to the crop. This somewhat surprising result is further looked into.

21. *"A statistical study of the relation between crop response to fertilizer and Soil factors and agronomic practices"*. By Shri B.K. Garg, I.A.R.S. (I.C.A.R.). New Delhi.

An attempt is made to investigate the relation between crop response to fertilizer with Soil Characteristics and Agronomic factors based on the data collected from extensive series of fertilizer trials in cultivators' fields by fitting linear regression Model. The technique of Discriminant function has been applied to see if these characters can adequately discriminate between the low and high crop responses available from the plots under the same fertilizer dose.

22. *Long term forecasting of per capita consumption of electricity in India*. By B.N. Sahu, Bihar State Electricity Board, Patna.

In this paper an attempt has been made to study the trend of growth of per capita consumption of electricity in India with the help of data released by the Central Water & Power Commission in the "Public Electric Supply, All India Statistics, General Review". On plotting the values of per capita consumption of electricity in India over years for the period 1951 to 1965-66, it is observed that the curve is taking an upward concave shape. Recognising this and also the reliability of fit for long term projection, the logistic curve of growth,

$$y = \frac{k}{1 + b e^{-at}} \dots \dots (i),$$

where y is the value of growth character studied at point of time t_i , and a , b and k are parameters to be estimated from the observed data $(t_i y_i)$ for $i=1, 2, \dots, 15$, has been fitted.

2. Differentiating (i) with respect to t and rearranging, the above form transforms into a simple linear regression of $\frac{1}{y} \frac{dy}{dt}$ on y such as,

$$\frac{1}{y} \frac{dy}{dt} = a \left(1 - \frac{y}{k} \right) \dots \dots (ii)$$

which has been used for the estimation of a and k . The linear regression of $\left(\frac{1}{y} \frac{dy}{dt} \right)$ of y finally takes the form ;

$$\frac{1}{y} \frac{dy}{dt} = .09445 - .0001268y \dots \dots (iii)$$

where $\frac{1}{y} \frac{dy}{dt_i} = \frac{1}{2} \log_e \frac{(y_i + 1)}{y_i - 1}$ $i=2, \dots, (N-1)$

3. By using the form,

$$\log_e b = a \frac{(N-1)}{2} + \frac{1}{N} \sum_{i=0}^{N-1} \log_e \left(\frac{k}{y_i} \right) \dots \dots (iv),$$

the value of b has been worked out to 41.7669. Finally substituting the estimated values of a , b and k in (i), the expected values of per capita consumption of electricity from 1951 to 1965-66 have been worked out. The above logistic curve of growth has also been used to project the per capita consumption of electricity right up to the year 2001.

23. *Fractional Diallel Analysis*. By G. Hariharayana and J. Ram, I.A.R.I., New Delhi.

The efficiency of two triangular designs related to PBIB designs was compared with the full diallel and [the circulant partial diallel corresponding, nearly, to $s = \frac{n}{2}$ where s is the number of crosses per parent and n is the number of parents. A comparison of the estimates of genetic variances and the general combining ability effects revealed the superiority of the triangular design-1 over its complementary design and the partial diallel where the number of parents involved are the same. This was also reflected in the average S.E. $(g_i - g_j)$ and the error square loss.

It was pointed out that the use of triangular partial diallel designs is limited because of the restriction imposed on the number of parents. The adequacy of a circulant partial diallel design corresponding to $s = \frac{n}{2}$ for screening a large number of parents because of their flexibility, in spite of its minor computational difficulties is discussed.

24. *Factorial Experiments with Additional Treatments*, By Lalit Kishore and M.N. Das I.A.R.S., New Delhi.

Augmented symmetrical and asymmetrical factorial design are frequently used. In the known augmented designs all the additional treatments are allotted to each block of a factorial design thereby making the block size larger. In the present paper we have suggested some new series of designs where the blocks of the confounded factorial design are made incomplete in respect of the additional treatments also by allotting to them only incomplete sets of the additional treatments. The method of analysis for these designs has been worked out and the precision of various comparisons like main effects efficiency of such designs has also been studied.

Such designs offer an opportunity to study if the effect of any factor when estimated as an average over the levels of other factors, differs from the pure effect of the factors, that is, when estimated in absence of all the other factors. The data from an experiment conducted in I.A.R.I. have been analysed with this end in view and the results have been discussed.

25. *On the Variance of Mickey's Unbiased Estimators* By N.S. Sastry, C.R.R.I., Cuttack.

Sastry (1964) in his unpublished thesis on 'unbiased ratio and regression type estimators' has investigated various problems regarding the precision of Mickey's (1959) unbiased estimators. This communication presents some additional results.

Exact variances of Mickey's general estimators T_m and T_m^* ; and unbiased estimates of these variances are derived. As a special case, exact variance of Hartley and Ross (1954) unbiased ratio estimate as given by Robson (1957) is obtained. Variance expressions of T_m and T_m^* are considerably simple for the choice $m=1$. If the finite population correction is ignored, with a single auxiliary variate x , the minimum possible variance of T_m^* form $m=1$ is shown to be

$\sigma_y^2 (1-\rho^2)/n$ upto the order $1/n$, where $\sigma_y^2 = V(y)$ and ρ is the correlation between y and x . This minimum is achieved for the choice $E[a(z_m)]_{m=1} = \rho^3$, the regression coefficient of y on x . If both \bar{X} and $V(x) = \sigma_x^2$ are known, with the choice $a(j) = y_j (x_j - \bar{X}) / \sigma_x^2$, estimator $T_m^*(m=1)$ is an unbiased regression estimator with the same large sample variance as the usual biased linear regression estimator. This estimator is superior in precision to Hartlyor-Ross unbiased ratio estimator and the usual biased ratio estimator. With P auxiliary variates and $m=1$, the minimum possible variance for Mickey's unbiased estimators is $\sigma_y^2 (1 - \sigma_y^2 \cdot 12 \cdot p) / n$, upto the order $1/n$, where $\rho_{y \cdot 12 \dots p}^2$ is the square of multiple correlation coefficient between y and x_1, x_2, \dots, x_p . The minimum is achieved for the choice $E[a_i(z_m)]_{m=1} = p_i$; the partial regression coefficient of y on x_i . If the variance-covariance matrix $\| \sigma_{ij} \|$ of the x 's is known, with the choice $a_i(j) = \sum_{k=1}^P \frac{\sigma_{ik}}{\sigma_{jj}} (x_{kj} - \bar{x}_k)$, where $\| \sigma^{ij} \|$ is the inverse of $\| \sigma_{ij} \|$, the estimator $T_m^*(m=1)$ is a minimum possible variance unbiased regression estimator based on P auxiliary variates. These results are all extended to double sampling, where a preliminary sample is used to estimate the population means and variance-covariance matrix of auxiliary variables.

26. "On some representations of integers in generalized Fibonacci numbers and a related probability distribution". By S.G. Mohanty, Indian Institute of Technology, Delhi.

A minimal representation of any positive integer N in generalized Fibonacci numbers $\{F_t\}$ (i.e., $F_1 = \dots = F_r = 1, r \geq 2$, and $F_t = F_{t-1} + F_{t-r}, t > r$) is a vector (a_r, \dots, a_n) of elements 1 or 0 with $a_n = 1$ satisfying the properties.

$$N = \sum_{i=r}^n a_i F_i, F_n \leq N < F_{n+1}, n \geq r$$

and $a_i \cdot a_{i+j} = 0, i \geq r, j = 1, \dots, r-1$

Analogous to minimal representation, a maximal representation of N in $\{F_t\}$ is defined and some of the properties of these representations are studied. The number $U(n; m_1, \dots, m_r)$ of $N, (F_n \leq N < F_{n+1}, n \geq r)$ such that in the minimal representation of N , there are exactly $m_i a_j$'s among non-zero a 's except a_n , with $j \equiv i-1 \pmod{r}, i = 1, \dots, r$, is determined. An r -coin tossing game is

formulated and the probability distribution of the duration of the game is obtained, with the help of $U(n; m_1, \dots, m_r)$.

27. *A note on the Selection of Districts from different States for studies of trends over time.* By M.S. Avadhani and V.N. Amble, Indian Society of Agricultural Statistics, C/o I.A.R.S. (I.C.A.R.), New Delhi.

A method of classification of districts in the country with reference to the extent of changes in their geographical content, which occurred during the period from 1921-1961 owing to territorial redistribution of Provinces by the British prior to Independence and subsequent reorganisation of the States, is discussed in this note. All the districts into which the country was divided as at 1961 census period are classified and tabulated State-wise in accordance with this principle. The utility of the results of the note is briefly indicated.

28. *Factor Analysis in Relation to Breeding System.* By B.R. Murty, V. Arunachalam and O.P. Jain, I.A.R.I., New Delhi.

The forces of divergence in the cultivated populations of crops belonging to different breeding systems *i.e.* Sorghum, Pennisetum, Brassica, linseed and wheat have been examined utilizing the Centroid method of factor analysis. The populations consist of mostly elite material of high productivity. In the case of linseed, the effect of the inclusion of F_1 hybrid on the factor loading has also been examined while in Brassica, the effect of disruptive selection on the forces of divergence was investigated. In Pennisetum and Sorghum, large collections of these crops from all over the world [with practically little human selection have been studied.

In general, three factors were found to be adequate to account for most of the total communality although nearly fourteen variables have been included. The results in general confirmed that the use of genetic correlation matrices in populations under intensive human selection would change the factors loading to a considerable degree as compared to the environment correlation matrices similar to those observed in Sorghum (Murty and Arunachalam, 1966). [The number of factors and the loadings did not appear to be directly related to the breeding system but were found to be influenced by the past history of selection. In general, the [first factor which contributed the maximum to the total communality was concerned with characters influencing [major components to fitness under both human and

natural selection. In general, 80% of the total communality was accounted by the first two factors.

The factor loadings in Sorghum were similar to those reported earlier for representatives of the world collection indicating the important role of growth factor and reproductive factor. The third factor in Sorghum was related to some wild characteristics such as awning.

Glume colour and glume covering which were considered important in the classification of this genus appeared to be of negligible importance in any of the factor loadings while plant height and length of primary branches and number of leaves were important both in the first and second factors.

In the case of linseed, the inclusion of F_1 's hybrids did not change the major conclusions drawn about factor loading. The factors from the genotypic correlation matrix were similar to those of the environmental correlation matrix for important characters influencing yield and fitness.

In the case of Pennisetum, ear girth, ear length, and height were important in the first factor, while flowering time was predominant for the second factor. In the third factor, early vigour and ear girth were important. In Pennisetum also, the reproductive capacity appeared to be important as judged by the factor loadings.

In Brassica, the factors from the genotypic correlation matrix were different from those of the environmental correlation matrix although considerable similarity so far as characters for productivity and survival are concerned.

In Brassica the data have also indicated the disruptive selection for flowering time had modified substantially factor loadings in the case of genotypic correlation matrices and has, therefore, substantially modified the course of evolution. The factor loadings were mostly in favour of characters important for survival under mixed cropping.

29 *Estimating the size of a mobile population from Recapture data when there are two types of animals in the population.* By P. Mukherjee, State Statistical Bureau, Calcutta

In this paper an attempt has been made to estimate the size of a mobile population utilising recapture data when there are two types of animals in the population. The maximum likelihood solution

of the problem based on Lincoln's sampling procedure and Jackson's negative method has been developed. Jackson's (1939) data on tsetse flies together with fictitious data on the other type of insects have been subjected to the negative method. The estimates have been found resulting in an obvious departure from Jackson's estimate of tsetse flies.

30. "*On the use of more than one auxiliary variates*". By G.K. Mishro, Bureau of Statistics and Economics, Orissa, Cuttack.

Discussing on the use of more than one auxiliary variates Olkin (1958), Sukhatme and Koshal (1959) and Goswami and Sukhatme (1965) have suggested to build up different ratio estimates with the help of different auxiliary variates and to take a weighted average of the different estimates for the character under study with the help of an optimum weightfunction. Here a different approach is suggested. It has been seen that use of some of the readily available auxiliary variates to estimate the population means of some other auxiliary variates which are ultimately used to estimate the character under study improves the efficiency of the estimate under some conditions. Also the optimum sizes of the two samples in case of Double Sampling have been determined and the efficiency of the estimate based on double sampling has been compared with that of unistage sampling. Application of cluster sampling has also been discussed.

31. *Crop estimation surveys some points for investigation*. By Ram Gopal, National Sample Survey, Faridabad

In India sample survey has now become an accepted procedure for the estimation of crop yield in all the States. The paper discusses some points like non-response, substitutions etc. affecting the reliability of the estimates, which it is felt, require further investigation by the Statisticians in the field. The paper also suggests the directions in which the investigation may be taken up.

32. *Some Sampling Procedures for estimating the phonemic and graphemic frequencies of a language*. By S.G. Prabhu-Ajgaonkar, Deccan College, Poona.

Phonemes and graphemes are fundamental elements of utterances and writings respectively of a language and their frequencies play a prominent role in its analysis and in many practical applications. Attempts have been made in the past to ascertain their values by Whitney (1893), Dewey (1923), Haydan (1950) for the English

language, by Josselson (1953) for the Russian language. For the Indian languages the frequencies have been determined by Bhagwat (1961) for Marathi, by Ghatage (1964) for Hindi, by Pandit for Gujarati. These studies are based on huge samples consisting of nearly one lakh words selected from the available literature. In many cases the selected material is classified depending on its nature and different rates of sampling have been used in securing the final data. A majority of these studies has extensively employed the systematic selection procedure and the word as the ultimate unit of sampling.

The present study is concerned with the effect of different types of sampling on a linguistic population. To begin with a well defined linguistic corpus is considered with the help of Professor of linguistics. The population is spread over 310 sheets, each sheet containing 30 elements. For the determination of frequencies, ten characters are chosen and the following three different sampling procedures are employed to yield samples of sizes 100.

1. A simple random sampling procedure.
2. 930 groups are formed, each group consisting of ten elements. 10 groups are selected randomly and all the elements in these are enumerated. This procedure is called replicated systematic.
3. First a sample of size 50 sheets from the 310 sheets is randomly drawn and from the every selected sheet two elements are sampled, thus yielding a two-stage sample of size 100.

Subsequently it is noted that in a majority of cases the two-stage sampling procedure is best and that the simple random sampling procedure is better than the systematic sampling procedure.

33. "*Successive Sampling in two stage Design*". By Arun Saxena, Lucknow.

The problem of sampling on two occasions in two stage sampling design with partial replacement of units at both the stages has been considered in this paper. The estimate of population mean and its variance has been worked out with minimum variance method. Two estimates of change and their variance based on average method and minimum variance method have also been worked out. The results have been illustrated utilising the data collected during

1961-63 under the scheme for estimation of the extent of cultivation practices and yield rate of cashewnuts in Kerala State.

34. *On the Efficiency of an Estimator in Sampling on two Successive Occasions*. By M.S. Avadhani, I.A.R.S., New Delhi and B.V. Sukhatme, Iowa State University, U.S.A.

For estimating the mean of a finite population on the second of two successive occasions under simple random sampling scheme without replacement the authors have proposed elsewhere an estimator which utilises the data obtained from the sample drawn on the first occasion as ancillary information. In this paper it is shown that this estimator is more efficient than the one similar to that of Pathak and Rao (1967) in all situations where the well known ratio estimate under simple random sampling provides no less efficient estimate of the parameter in question than either the usual linear regression estimate or the P.P.S. without replacement estimate of Rao et al (1962). Also, it is proved that the expected gain in efficiency tends to 100 per cent when the coefficient of correlation between the characteristics on the two occasions approaches unity.

35. *"Effect of missing observations on Rao-Hartley and Cochran Sampling Scheme"*. By A.K. Srivastava and B.V. Sukhatme, I.A.R.S., New Delhi.

Rao et-al (1962) suggested an unequal probability sampling scheme for selecting n units from the population by dividing the population units at random into n groups and taking one unit with probability proportional to its relative size independently from each group. The scheme has got a number of advantages over other unequal probability sampling schemes. However, when some sample observations are missing, the R.H.C. (Rao-Hartley-Cochran) estimate of the population total, based on the available observations, is not unbiased. A corresponding unbiased estimate has been considered which shows a considerable increase in its variance. Two alternatives to the R.H.C. scheme together with the estimates of the population total are considered and it is shown that these estimates are more efficient than the R.H.C. estimate in case of missing observations, under some conditions.

36. *Methods for Evaluation of Chick mortality Rates in Poultry-farms*. By K. Easwarankutty (Trichur) and T. Janardhana Menon (Trivandrum).

Different methods of evaluating the percentage mortality of chicks below 3 months of age and thus assessing the survivability rates from the records maintained in the poultry farm attached to the Kerala Veterinary College and Research Institute, Trichur, have been described and the draw-backs inherent in each method discussed briefly. From a study of the trends in daily mortality percentage of chicks from the hatch history records maintained in the farm, the following results were obtained.

1. A second degree regression equation.

$$Y=0.2707+0.01013X-0.000148X^2$$

connecting the percentage of daily mortality, Y and the age in days X is found to fit the data very well, even though it fails to represent the very low mortality rates during the first two or three days.

2. The conditional parabolic regression.

$$Y=0.022X-0.000257X^2$$

of the percentage daily mortality on age in days, even though it passes through the origin is not as satisfactory as the general parabola.

3. The overall percentage of mortality of chicks of 3 months of age and below was found to be approximately 30 and therefore their survivability can be placed at 70 per cent.

37. *Post Livestock Sample Survey in the Punjab State.* By Sudarshan Kumar, Chandigarh.

To estimate the livestock number and collect information on breed, order and stage of lactation completed, month of calving age composition etc., a sample survey was conducted in the Punjab State during May-June, 1966.

The Plan for the sample survey was one of multistage stratified sampling. In rural area, a tehsil was the stratum while in urban area a district was the stratum. Results derived are discussed in the paper.

38 *Prediction of First Lactation Milk yield of an individual cow of Kankrej Herd.* By K.M. Shah and R.M. Patel, Anand.

A study was undertaken to develop an equation to predict the lactation milk yield of an individual cow of Kankrej herd utilizing information of its partial performance of first twenty weeks (X_1), yield (X_2) and persistency (X_3). The yield records of past 22

years (1944 to 1965) maintained at the Institute of Agriculture, Anand, were utilized for this purpose.

The first lactation milk yield is positively correlated with the partial performance of first twenty weeks, peak yield and persistency. The contributions of these factors were worked out individually as well as in combinations to assess their usefulness in predicting the first lactation milk yield. The partial performance of twenty weeks has been found to be the most useful predictor. It accounted 62.13% of the total variation in the first lactation milk yield. Persistency contributed to some extent. Peak yield did not prove useful. Utilizing the partial milk yield of twenty weeks (X_1) and persistency (X_3) the following prediction equation has been obtained :

$$Y = -589 + 2.206X_1 + 219.1X_2.$$

39. "*On Stratification in Sampling Investigations Involving more than one Character*". By G.R. Seth & P.C. Gupta, I.A.R.S., New Delhi.

Determination of strata boundaries in case of stratified sampling has been studied by Dalenius and some other workers. Ghosh has studied two-way stratification for the study of two characters and has discussed optimum boundary points which minimize the generalised variance of unbiased linear estimates. In the present study, stratification for the study of two characters on the basis of third auxiliary character has been investigated. Equations whose solutions give the boundary points have been obtained which minimize the generalised variance of unbiased linear estimates assuming proportionate allocation among strata. These solutions reduce to the one obtained by Dalenius for the study of single character in cases where the characters under study have linear regression on the stratifying auxiliary variables. Specific solutions have been obtained when the trivariate distribution follow multi-variate normal exponential and uniform distribution.

40. *On the Relative Efficiency of Line Intercept, Point Quadrat and Parker's Loop Methods for Sampling Vegetation in range lands*. By M.B. Jain, R.K. Gupta, S.K. Sexena and R.K. Bohra, CAZRI, Jodhpur.

Although much work has been done in recent years on sampling vegetation, the relative accuracy and the degree of personal error inherent in different sampling methods, have not been studied

study was, therefore, designed to investigate the relative performance of the most widely used sampling methods viz. line intercept, vertical point quadrat and Parker's Loop methods on three different range types in Western Rajasthan.

For studying relative accuracy, percentage basal area was measured by all the three methods and also by charting method on ten randomly selected transects, 10 metre long, in 3 different range types. The personal error inherent in the different methods was measured by using a 4×4 latin square design with randomly selected transect, order of recording observations on the selected line and observer as the three criterion of classification.

In all the habitates, the estimates obtained by line intercept method were very close to those obtained by charting whereas point quadrat and loop methods significantly overestimated the percentage basal areas. The percentage standard errors were approximately of the same order. For a given precision, loop method was, however, found to be the most rapid. The observers difference were non-significant in case of line intercept method whereas significant observer's differences existed in case of other two methods. The percentage observers variation were of the order of 3.6, 8.5 and 11.1 for line intercept, point quadrat and loop methods, respectively. Annuals as compared to perennials contributed to more variation between these methods.

Hence, from the point of view of accuracy, efficiency and consistency line intercept method has been found to be the most suited for estimating basal area of vegetation in range lands of western Rajasthan.

41.. *Application of Path Coefficient Analysis to Problems of Plant Breeding in Rice.* By N.S. Sastry, M.J. Balakrishna Rao and S. Rawlo, C.R.R.I., Cuttack.

In rice, the recent concept of an ideal 'plant type' has brought into sharp focus the implications on plant height; invariably short stature habit is being considered a necessary criterion to achieve success in plant breeding programmes. However, among the ideal plant type varieties themselves, there are varieties like *Taichung (Native)-1* and *I.R.8* having clearly higher yield potential. Probably the short stature of such varieties might have combined well with other morphological characters of the plant in producing a desirable effect on yield. A study was made using Sewall Wright's path

coefficient analysis to understand such fundamental relationships between characters like plant height, number of ear bearing tillers, mean panicle length, sterile grain number per plant and 100-grain weight, in relation to yield, in a representative group of short statured varieties.

The analysis showed that variety *Dee-Geo-Woo-Gen* possesses the best germplasm to transfer 'short stature' that is capable of combining with advantageous improvements in yield components. Experience in regard to *Taichung (Native)-1* and *I.R.8* for both of which *Dee-Geo-Woo-Gen*, was the contributor of the dwarf habit amply supports this view. Whereas in *Tichung (Native)-1* short stature has combined well with number of ear bearing tillers alone, in *I.R.8* combination of short stature with ear bearing tillers, panicle length, number of grains per panicle and 100-grain weight has been the reason for its higher yield potential than even *Taichung (Native)-1*. In short statured varieties, in general, as the number of ear bearing tillers increases, a considerable increase in the unfertile grains per panicle results. The profitable balancing limit between panicle number and sterile grain number appears to have been reached in *Taichung (Native)-1*, and selection for any further increase in tiller number in crosses with this variety may result in decreased yield. Instead, selection for improving panicle length and 100-grain weight without much loss in ear bearing tillers seems to offer better results in crosses with *Taichung (Native)-1* or even *Dee-Geo-Woo-Gen* as evident in the case of *I.R.8* in comparison with *Taichung Native)-1*.

42. *An application of a probability distribution for the cohort fertility.* By S.N. Singh and K.B. Pathak, Banaras Hindu University and Institute of Social Sciences, Kashi Vidyapith, Varanasi.

Under certain assumptions a probability distribution for describing the variation in the number of births during a given period (O,T) has been obtained. The distribution has been applied to the data of Dandekar (1955). Application of the distribution for studying the effectiveness of the contraceptives and their effect on the total fertility performance of the woman has also been discussed.

43. *Comparative Study of different methods of indexing sires* By J.P. Jain and J.C. Malhotra, I.A.R.S. (I.C.A.R.), New Delhi.

The relative merits of eleven different methods for estimating the breeding worth of dairy sires have been discussed. Two of these methods use information on daughters' production only.

Records of daughters and their dams are utilised in three other indices whereas the remaining six use information on daughters and their contemporaries with or without records of their dams. The index, $A + \frac{1}{2} h^2 Q \left[(\bar{D} - C_D) - b (\bar{M} - C_M) \right]$ has been shown to be the most satisfactory both from the consideration of logic and efficiency in terms of least mean squares. This index adjusts the daughters' average for the differences in the production level of dams allotted to different sires, numbers of daughters available for testing as also for the variation in environmental conditions from period to period. The use of these indices has been illustrated with the data on milk production in the Kangayam herd at Livestock Research Station, Hosur (Madras State).

44. "*Correlation between relatives under inbreeding in presence of genotype \times environment interactions*". By K.M. Reddy, I.A.R.S., New Delhi.

Changes in the behaviour of similar genotypes in diverse environments are defined as genotype \times environment interactions. Introducing new parameters g_{aa} and g_{ra} , Mathur and Jones (1958) gave a method of estimation, in random breeding population. In general the random mating seldom occurs, and a kind of regular system of mating or a combination of regular kinds of mating are seen to prevail. In this discussion only one kind of regular system of mating is considered at a time such as selfing, full-sib mating or parent off-spring mating, to find out the correlation between relatives, in presence of genotype \times environment interactions. Under these regular systems of mating some particular cases are considered for use in practical problems.

45. *Optimum allocation with multiple characters for assessment surveys of I.A.D.P.* By S.S. Narula, I.A.R.S. (I.C.A.R.), New Delhi.

At present allocation of number of experiments in different strata in the crop cutting surveys of the Bench-mark and Assessment Surveys of I.A.D.P. is made proportional to the area under a crop in each strata for studying precisely one character namely yield only. The I.A.D. Programme has made substantial progress in some of the districts in production as well as in other characters like adoption of fertilisers, plant protection chemicals, improved practices and managerial ability. It is of great interest to get the information as precisely as possible on all the characters simultaneously in such surveys. When more than one character are considered

simultaneously the problem of allocation becomes complicated as the allocation which is best for one item is not best in general for another. Several compromise plans have been suggested by various research workers. Neyman suggested to take the average of the optimum allocation of all the multiple characters under study. Peter and Bucher (1940) suggested to maximise the total sum of the relative efficiency for all the characters where relative efficiency of the estimate of a character has been defined as ratio of the variances based on Neyman's allocation and that based on arbitrary allocation. Seth (1951) Delanius (1953) suggested the adoption of allocation which minimises some function of the dispersion matrix of the estimates of all the characters. Cochran (1953) suggested to minimise the total sum of the ratio of the variances based on the arbitrary allocation to that of its optimum variance for all characters. Gosh (1958) indicated to minimise the determinant of the generalised variance of the estimates of various characters. Nordbotten (1956) gave solution to solve this allocation problem by means of linear programming. In this paper a plan is studied, in which allocation in different strata is done on the basis of a linear function of the optimum allocation of the characters. Coefficients like inverse of variance or the coefficients of variations of each character or the coefficients of elasticity of each character as obtained in the production function have also been studied. In this paper efficiencies of the different methods of allocations as advocated by earlier research workers and by the author of this paper have been worked out and compared.

46. *Study of marketable surplus in the eastern I.A.D.P. districts* By P.N. Bhargava and V.S. Rastogi, I.A.R.S. (ICAR), New Delhi.

A study of marketable surplus in relation to agricultural production has been carried out on the data collected under the Benchmark and Assessment surveys under the I.A.D.P. The data relates to the three years' period viz., 1962-63 to 1964-65 for the districts of Shahabad (Bihar), Burdwan (W. Bengal) and Sambalpur (Orissa). The aim of the study is to find a suitable marketable surplus function for total production which explains the marginal and average propensities to sell with respect to output and hence the output elasticity of sale. The policies to be adopted for the increasing of marketable surplus under the suitability of various functions has also been discussed. It has been shown that the quadratic function is the most suitable one to explain the relationship.

47. *On the Estimation of Generalized Linear Probability Model Involving Discrete Random Variables.* By A.R. Roy and V.K. Srivastava, Lucknow University.

The article deals with the generalized linear probability model to explain the variation of proportions in multi-classification problems. In the estimation of the coefficients of such a model it is observed that the variance-covariance matrix of disturbances is not non-singular so that Aitkin's generalized least-squares theory cannot be applied directly. Under such an assumption (accompanied with other usual assumptions of least-squares theory) we have derived an expression for the estimator and its asymptotic variance-covariance matrix. A procedure has also been developed for the simultaneous estimation of a set of relationships and its asymptotic properties studied.

48. *The Chi-square analogue for normal population with class intervals defined in terms of the sample quartiles*". By A.R. Roy and R. Bhargava, Lucknow University.

Consider a normally distributed random variable x with variance unity and unknown population quartiles $\theta_1, \theta_2, \theta_3$. The sample of size n consists of x_α 's $\alpha=1, 2, \dots, n$ and m_i 's are the number of x_α 's in the four classes $(-\infty, x_1), (\bar{x}_1, \bar{x}_2), (\bar{x}_2, \bar{x}_3)$ and $(\bar{x}_3, +\infty)$ defined in terms of the sample quartiles \bar{x}_1, \bar{x}_2 and \bar{x}_3 . The asymptotic distribution of

$$R_n^* = \sum_{i=1}^n \frac{[m - np_i^*(\hat{\theta})]^2}{np_i^*(\hat{\theta})} \quad \text{is } \lambda_1 y_1^2 + \lambda_2 y_2^2 + \lambda_3 y_3^2$$

being the positive roots of the equation $|\Sigma - xP|$, Σ being the covariance matrix and P a non-singular matrix. y_1, y_2, y_3 are independently and normally distributed with mean zero and variance unity.

49. *Zero-One Integer Programming Problems.* By A.R. Roy and A. Sahai, Lucknow University.

The paper deals with a problem in the area of Inter-programming. Variables here are not only restricted to take integer values but are to take one of the two values 0 and 1. Such problems are not uncommon in practice and many nonlinear problems convertible in an integer linear programming problem conform to the same.

Quite recently Egon Balas and Fred Glover have been successful algorithms to solve such problems.

In this article a new approach has been tried for solving zero-one integer linear programming problems. In fact, this could be done by expressing the additional zero-one requirement in form of a quadratic constraint. The way, this particular constraint has been treated is a second-hand one and is that of Christoph Witzgall for the parabolic constraints.

A brief historical review precedes the main description of the paper. Mixed cases have also been taken up. A different procedure that of Kanti Swarup and S.P. Agarwal for Fractional Functional Programming Problems with a quadratic constraint has also been indicated for the mixed 0-1 integer-continuous programming problems.

50. *Latinized Sampling* By S.K. Chatterjee and R.D. Mishra, Lucknow University.

In this paper an alternative sampling procedure has been considered for the usual systematic sampling situation. For selecting a sample of size n from a population of $N=nk$ units which are serially numbered in a sequence, the units are considered as arranged in an $n \times k$ table as in systematic sampling. Then a method of selection which ensures one selection from each row of the table and which at the same time favours all the columns of the table equally is considered. The estimation problem and efficiency relative to other comparable procedures have been studied

51. *A Double Sampling Estimator in Sample Surveys*. By Surendra K. Srivastava, Lucknow University.

A double sampling estimator of the ratio-type for estimating the mean \bar{Y} of a finite population has been considered where the value of $\rho C_y/C_x$ can be guessed in advance. The estimator considered is

$$\bar{y}_{ds} = \bar{y} (\bar{x}/\bar{x}\alpha)$$

where α is obtained to minimise the variance of \bar{y}_{ds} , and comes out to be $\rho C_y/C_x$ multiplied by a simple function of n' and n , the sizes of the preliminary large and the small samples respectively.

For the exact value of $\rho C_y/C_x$, the estimator has a smaller large-sample variance as compared to both the ratio and the linear regression estimators in double sampling in case where the two samples are drawn independently from the population. If the small

sample is a subsample from the larger sample, the estimator has a large-sample variance equal to that of the linear regression estimator. The largest value of the difference between the guessed value and the exact value of $\rho C_y/C_x$ has been obtained so as not to result in the variance of the estimator larger than the variances of the ratio and the linear regression estimators. The optimum value of n' and n have also been obtained for a simple cost function.

52. *Acceptance of Sanitary Composting in Rural Areas.* By V.K. Srivastava, Lucknow.

An action programme for developing effective fly-control methods capable of being extended to rural areas was carried out under the auspices of Indian Council of Medical Research at Planning Research and Action Institute in the village Pehia of district Lucknow. Method of sanitary composting of fly-breeding organic was the fly-control devise. The technique was popularized with the help of a field assistant and a health educator who imparted health education on a sanitary composting, fly and fly borne diseases to ensure people to practice a composting for their household wastes. The programme resulted in a coverage of 71% of the household.

In this article an attempt has been made to develop a model to predict the innovativeness. For the purpose three categories of acceptors, viz., Innovators, Early adopters and comparatively late adopters, are studied. It has brought out few important factors that have influenced the acceptance of compost pits, e.g., size of the land holding, availability of cattle litter, requirement of manure, availability and capability of household members to carry the house refuse, cattle litter, etc., to pits distance of pit from the house, socio-political status and progressiveness (in the sphere of agriculture) of the people. It has also been found that a change in agricultural practices is quickly adopted if it is compatible with the existing practices and ideas, and if it can make the people perceive a need for it. Moreover, people are more receptive to change in which some immediate advantage is readily available.

53. *A Study of Savings from Agricultural Incomes* By M.P. Sastry and V. Vijayalakshmi, Tirupati (A.P.)

Methodological studies on savings are entirely lacking. An attempt is made in this paper to study stable behaviour of savings pattern for some types of income distribution. The construction of savings model is based on its similarity with the contents of a dam-model. The stable distribution of savings is studied when incomes

follow a X^2 -distribution with n degrees of freedom. As the degrees of freedom are changing the change in the stable probability distribution of savings is studied for agricultural incomes. It has been observed from the study that as income distribution is approaching a normal distribution the probability for higher saving is becoming very high.

54. *Distribution of Phase-type in Cultures of S-Typhi—a Statistical Study.* By G. Sadasivan and S.C. Rai.

In this paper, the statistical examination of the distribution of Phage-types of S-typhi typhoid organism at different centres in India, are made. S-typhi is one of the three most important groups of bacteria which causes typhoid. Phagetypes are bacteria eaters formed on the intestinal canal of humans and animals. Under S-typhi 14 phage-types are reported and these phage-types are carried by humans. It is hypothesised that the proportion of these phage-types among humans is the same in different areas of the world. In this paper this hypothesis is tested with the help of some data obtained from different centres in India. The Statistical techniques that can be adopted for testing this hypothesis are described. In particular, the power of two tests that can be used for this purpose, namely Chassen's test for order and Barthomolon's \bar{X}^{-2} test are being investigated.

ANNOUNCEMENT

The Indian Society of Agricultural Statistics has decided to publish scientific papers in Hindi in the theory of Statistics and its application in the fields of agricultural and biological sciences in the journal of the Indian Society of Agricultural Statistics. The Editors would welcome original articles and notes in Hindi for possible publication in the journal. Manuscripts either typed or hand written with sufficient margin should be sent in duplicate along with a short summary to the Editor, Journal of the Indian Society of Agricultural Statistics, C/o Institute of Agricultural Research Statistics, New Delhi-12. Authors will receive 25 reprints of their papers free of cost. Additional copies will be made available on payment.