

ABSTRACTS OF PAPERS PRESENTED AT THE 29TH
ANNUAL CONFERENCE OF THE SOCIETY HELD
AT UNIVERSITY OF RAJASTHAN, JAIPUR IN
DECEMBER, 1975

1. **Multivariate Analogues of Multiple Comparisons Methods**

By O.P. Bagai, *Department of Statistics, Punjab University, Chandigarh.*

A procedure for forming clusters of like population has been evolved where the departure has been made from Rao's subjective approach.

Two stages have been suggested. Stage I is a sort of prediction where Rao's graphical approach has been made use of after finding significant discriminant scores. Stage II corrects a predicted cluster where a new definition is first given and then as many as three alternatives are suggested. In each alternative, unlike Rao and Tocher, we are able to give probability to our decision. Further one of the alternatives is demonstrated by an illustrative example with the help of 14 species of trees, each tree having four measurements concerning its static bending property. Our working criteria for forming clusters of like populations in all the three alternatives are Multivariate Analogues of that used by Fisher, Student-Neuman-Keul, Schaffe and Tukey in forming similar groups of like treatments in the univariate analysis of variance.

2. **Analysis of EGD and Hypercubic Designs as Factorial Experiments**

By K.R. Aggarwal, *Punjab Agricultural University, Ludhiana-4.*

This paper contains the analysis of the extended group divisible (EGD) designs with (2^m-1) associate classes (Hinkelmann, K. and Kempthorne, O. *Biometrika* (1963), 281-291) and hypercubic designs with m associate classes (Shah, B.V. *Ann. Math. Statist.* (1958), 766-779) when these PBIB designs are taken as the confounded factorial experiments of the type $s_1 \times s_2 \times \dots \times s_m$ and s^m , respectively. For these two classes of non-orthogonal designs, the total sum of squares (S.S.) eliminating blocks, has been orthogonally split into S.S.

due to the various main effects and interaction effects. There are two aspects of the analysis of the confounded factorial experiments which are of special interest to the experimenters. One aspect is the working out the relative loss of information on each of the partially confounded degrees of freedom and the other aspect is the working out the Anova Table for testing the significances of the various contrasts said to belong to the main effects and interaction effects. The first aspect had been widely discussed in literature by the various research workers [See Chapters 13 and 14 of Raghavarao (1971). *Constructions and Combinatorial Problems in Design of Experiments*] and the second aspect is dealt in the present paper.

3. Some Results on Balanced Designs

By R. Chakravarty and A. Dey, *I.A.R.S., N. Delhi-12.*

A necessary and sufficient condition for an equireplicate pair-wise balanced design of index λ and type $(v; k_1, k_2)$ to be balanced, is obtained. A class of balanced n -ary designs with equal replications and two block sizes is constructed.

4. On Saturated Main Effects Plans in Asymmetrical Factorials

By Satyabrata Pal, *Bidhan Chandra Krishi Vishwa Vidyalaya.*

The non-orthogonal unsaturated main effects plans for asymmetrical factorials were developed by Saha *et al.* (1970) following the lines of Raktoo and Federer (1968) using a specialised definition of interaction advanced by Bose (1959). An interesting property was observed to be satisfied by a subclass of saturated main effect plans for symmetrical factorials developed by Paik and Federer (1970). This paper attempts to obtain saturated main effect plans in case of asymmetrical factorials in the above context. Non-singular saturated main effect plans and Singular plans are also defined. It has been proved that the generated saturated main effect (s.m.e.) plans from an original s.m.e. plan have got the same value of the determinant of their information matrices as of the original plan. The generated plans are derived by adopting the addition operations on the treatment combinations selected in the original plan. A lemma on the existence of singular plans has been obtained. A lemma on the existence of the maximum number (*i.e.* total no. of treatment combinations) of different plans in each of the generators is obtained.

and that of genetic variance as

$$\sigma_{gt}^2 = [1 - 2P_t \lambda_{t-1} - (2P_{t-1})^2] d^2 + 2P_t \lambda_{t-1} (1 - 2P_t \lambda_{t-1}) h^2 + 4P_t \lambda_{t-1} (2P_t - 1) dh$$

where

s is the selection intensity, $\lambda_0 = \frac{1 - P_0}{2 - P_0}$ (P_0 is the initial gene frequency), and $\lambda_{t-1} = \frac{\lambda_0}{1 + t\lambda_0}$.

It is found that the dominant gene increases in frequency with increasing selection pressure in each generation. Also for each value of dominance and selection intensity, the genetic variability is found to decrease with increasing value of initial gene frequency.

31. Probability of Occurrence of Crop Losses

By D. K. Agarwal, *I. A. R. S., New Delhi.*

In this paper an attempt is made to determine the frequencies of crop losses for different coefficients of variation since the crop loss in any season depends on the natural conditions beyond human control. It is seen that when the coefficient of variation is less, the probability of occurrence of crop losses would be much less. Thus there seems to be no danger of the crop insurance scheme being a failure, as the occurrence of heavy crop losses would be a rare phenomenon.

32. Stabilising Production of Rapeseed and Mustard

By Pranesh Kumar, V. K. Gupta and V. K. Bhatia, *I. A. R. S., New Delhi.*

During the past decade, with an increase in population, the foodgrains have been acquiring more importance as compared to other crops. As a result of the increasing demand of foodgrains, the prices of foodgrains have increased by a sufficient amount. In view of the present food crisis and diversified climatic conditions, it becomes a matter of interest to study the behaviour of variation in commercial crops. The present study is, thus, inclined towards studying the extent of variation in area, production and yield of rapeseed and mustard, searching out the causes of variation and forming a policy to stabilise the production.

A statistical analysis of area and yield of rapeseed and mustard revealed that there had been a significant difference in area under cultivation of this crop between years and between States. There had been no significant difference in arable land of this crop between pre-plan and first five-year plan periods. A highly significant difference in area under cultivation of this crop was observed between third and fourth five-year plan periods. Similarly, yield of rapeseed and mustard showed a significant difference between years and between States. However, there was no significant difference in yield between pre-plan and first five-year plan periods. But there was a highly significant difference in yield between third and fourth five-year plan periods. Incidentally, this period coincides with the period of genesis of improved agricultural inputs which brought in a break through in agriculture. It may also be mentioned here that the co-efficient of variation in area and yield was highest in Rajasthan.

Since the yield varied significantly from year to year and region to region, an analysis was made to stabilise the production of this crop by minimising the ability of a linear function of the type $\sum q_i Y_{ij}$, where

q_i = Proportion of area under the crop in i -th region

and

Y_{ij} = Yield of the crop in the i -th region during j -th year.

This analysis suggested that the area under this crop in Assam, Bihar and West Bengal should be raised whereas the arable land in Rajasthan should be reduced. In Madhya Pradesh and Uttar Pradesh there was a marginal difference in present and proposed area under this crop.

33. Sampling and Prediction

By K. C. Gautam & Padam Singh, *I. A. R. S., New Delhi.*

Regression relations are of very much use in predicting the value of one variable on the basis of the given value of another variable. The relative efficiencies of various sampling procedures for estimating population mean or total have been very well discussed in the literature. No attempt, however, seems to have been made in comparing the relative efficiency of various sampling procedures for determining a functional relationship in two or more than two variables. In this paper it is attempted to compare some of the

sampling procedures for prediction and it has been observed that all equal probability sampling designs perform a proximately equally well for prediction.

34. Choice of Strata for Estimating Sheep Population

By R. P. S. Malik, *Agro Economic Research Centre, H. P. University, Simla.*

Before a sample survey is launched, the first consideration is to specify the number and suitable strata into which the population units could be grouped. Stratification could be done on the basis of geographical contiguity of the units, or on the basis of their sizes or both. The problem of demarcating suitable strata for estimating sheep population is dealt within this dissertation. For this purpose the sheep population in the tehsil of Rajasthan as enumerated in the Livestock Census, 1956 was considered. The different methods for demarcation of stratification points were examined and the efficiencies for estimating total sheep population for a State, when these methods are adopted, are worked out. The comparative performance when the natural divisions of the State are taken as strata is also studied.

The results indicate that \sqrt{f} method, in general, fares better than the other procedures.

If this method were adopted, for construction of strata, the estimate of total sheep population as in 1961 census year was obtained using different methods of estimation namely, simple estimate, ratio estimate and regression estimate. It is shown that \sqrt{f} rule of construction of strata using regression method of estimation provides an estimate of total sheep population with smallest standard error.

35. A Study of Intercrops in the Cost of Cultivation of Apples in Tehri-Garhwal Region of Uttar Pradesh

By Jagmohan Singh

The estimation of cost of production of apples is quite complicated. An orchardist has to incur expenses for the first six years in raising apple trees from planting to the bearing stage. The only income during these six years, if any, is through Inter-crops. In the present investigations an attempt has been made to study the factors affecting the inter-crops utilizing the data for 36 orchards in Tehri

district of Tehri-Garhwal region collected through the sample survey for "Estimation of Cost of Cultivation of Apple and its Marketing Practices in Hilly Areas of Uttar Pradesh" during 1972-73 and 1973-74. It is observed that there is no effect of plant density or age of the orchard in inter-crops. However, it is hoped that the cultivation of inter-crops in the area available in the orchards would help in reducing the cost of production of apples.

36. Tractor Use and Cropping Pattern

By Bhagat Singh, *I. A. R. S., New Delhi.*

This paper deals with the effect of tractor use on cropping patterns. The percentage of areas under important crops on tractor farms have been compared with those under bullock farms.

The cropping has been studied under three broad heads viz. :—

- (i) area under Kharif cropping;
- (ii) area under Rabi cropping; and
- (iii) area under Sugarcane.

The results showed that the use of tractor facilitated cultivation of highly remunerative crops even though these crops needed more intensive farm operations and higher level of input use. Tractor-use made the cultivation of Wheat after Sugarcane during the same year a practical possibility by striking a balance between areas under Sugarcane (planted) and Sugarcane (rato on) getting an additional Wheat crop on that area in two years.

37. A Class of Useful Plans Based on m Class Cyclic Association Scheme for Partial Diallel Cross

By S. N. Bajpai & G. C. Chawla, *I. A. R. S., New Delhi.*

One to one-correspondence between plans for partial diallel cross with v parental lines and a partially balanced incomplete block association scheme on v treatment is well known. Das and Sivaram (1968) gave number of plans based on two associate and 3 associate classes. In these plans the number of crosses involved is $vn_i/2$ (when reciprocal crosses are excluded) for v parental lines. In the present paper the m class cyclic association scheme has been considered for constructing such plans. The m class cyclic association scheme not only provides smaller values of n_i and thereby considerable economy in experimental resources but also provides plans for such number of

varieties for which no two class association scheme exist. Mesnor (1965) proved that if number of varieties is of the form $4t+3$, no two associate class of P. B. I. B. exists. Consequently, we have no two associate P. B. I. B. for 7, 11, 19, 23, 27, 31, 39, 43...etc. However in present paper we have considered higher class associate designs based on m class cyclic association scheme for these numbers.

38. Zero Correlation Versus Statistical Independence

By V. J. Shrikhande & S. D. Sharma, *Rajasthan College of Agriculture, University of Udaipur, Udaipur.*

It is very well known that if two random variables are statistically independent, the correlation between them is zero. The converse that any two uncorrelated variates are statistically independent is not always true. This fact has often been demonstrated in the texts by citing examples. There appears to be no further investigation of this matter. In this article, the authors have obtained the conditions which need to be satisfied apart from zero correlation, so that the two random variables are statistically independent.

If $\rho(X^j, Y^k)$ is the simple correlation coefficient between j^{th} power of X and k^{th} power of Y , j and k are some integers belonging to the integer set I , the necessary and sufficient conditions for random variables X and Y to be statistically independent are

$$\rho(X^j, Y^k) = 0, \text{ for all } j, k \in I.$$

39. On Some Aspects of Three-Pee Sampling

By S. D. Sharma, *Rajasthan College of Agriculture, University of Udaipur, Udaipur* and M. N. Das. *NSSO, Faridabad.*

In order to assess the total log volume in a forest, the area units are commonly employed as sampling units. Grosenbaugh (1964 and 1967) had proposed a sampling scheme namely probability proportional to prediction abbreviated as three-pee sampling employing individual trees as the sampling units. He had shown that the new sampling scheme is more efficient than the customary sampling methods in forestry, under a model, more likely to be assumed for forest conditions. He suggested two types of estimators, the unadjusted and the adjusted one. The latter, which we have investigated here

and is a ratio type estimator, eliminates the variation introduced in the unadjusted estimator due to the lack of information on the total number of trees in the forest prior to selection. This lack of information seems to have a direct effect on the sample size which becomes a random variable. In this paper, we have obtained the expressions of variance and bias of this adjusted ratio type estimator to a first order of approximation. The adjusted estimator turns out to be more efficient than unadjusted estimator and has negligibly small bias under the assumed model. Further, the gain of adjusted estimator over the unadjusted one, is just equal to the variance of random sample size, showing thereby that the unadjusted estimator has been completely adjusted for the fluctuating sample size in three-pee sampling.

40. A Study of Pre-Harvest Forecasting of Yield of Jute

By D. Singh, H. P. Singh, Padam Singh and M. P. Jha, *I. A. R. S., New Delhi.*

Reliable estimate of total crop production well before the harvest is of considerable importance in price and import-export policies. The method of forecasting of crop production being used at present is based on eye estimates and hence is subjective. It needs to be investigated whether forecasting of production would be made more reliable and objective by taking into consideration biometrical observations on the plant during the various stages of its growth. Of the two components of crop production, acreage and yield, acreage presents comparatively simple problem. Ordinarily, acreage is much more stable than yield per acre. The acreage of a crop is usually influenced by the ratio of the price of that crop to those of competitive crops which prevailed during the previous year. In addition, weather also sometimes affects the change in acreage.

With a view to bringing out improvement in forecasting of jute crop through the use of measurement of biometrical characters the Institute of Agricultural Research Statistics in collaboration with the Department of Agriculture took a pilot study on jute crop in the States of Bihar and West Bengal during the year 1970-71 to 1973-74. In this paper we discuss various statistical problems in pre-harvest forecasting of yield of jute with the help of the data collected under the four years 1970-71 to 1973-74 in both the States.

41. An Econometric Analysis of Supply Functions of Mustard and Rapeseed in Selected States

By R. K. Pandey and V. K. Dwivedi, *I. A. R. S., New Delhi.*

The knowledge of product supply which relates output to input provides a frame-work for adjusting production and resource use. It may help in taking decisions regarding the appropriate level of procurement prices for commodities. It also aids in better policy formulation in the farm sector. The present study is confined to the study of supply behaviour of farmers growing mustard and rapeseed in the selected States in India.

The supply response was estimated from the data for the period from 1951 to 1972 obtained from Assam, Bihar, Gujarat, Madhya Pradesh, Rajasthan and West Bengal. The Nerlovian adjustment model was used in the analysis and the following two equations were estimated :

$$\text{Log } A_t = \text{Log } \alpha + b_1 \log A_{t-1} + b_2 \log p_{t-1} + b_3 \log \sqrt{p_{t-1} + U_t} \quad \dots(1)$$

$$\text{Log } A_t = \text{Log } \alpha + b_1 \log A_{t-1} + b_2 \log P_{t-1} + U_t, \quad \dots(2)$$

where

A_t = area under rapeseed and mustard in hectare ;

P_{t-1} = farm harvest price in Rs. per quintal ;

ρP_{t-1} = standard error of prices on time for four preceding years ;

α = constant, b_i = coefficients,

and

U_t = error term.

The least square techniques under usual assumption was applied to study the relation specified in equations (1) and (2). Data for the study was obtained from the various issues of Estimates of Area and Production of Principal Crops in India, Agricultural Situation in India, and Farm Harvest Prices, all published by the Directorate of Economics and Statistics, Government of India, New Delhi.

The results indicated that coefficient of price was statistically significant in the case of Assam and West Bengal. With the exception of Bihar, price coefficient was positive. Coefficient associated with the lagged acreage variable was significant in case of Assam,

Bihar, Gujarat and Rajasthan. Examination of Durbin-Watson d statistic indicates either the absence of positive serial correlation or "inconclusiveness" in the series. To test the serial correlation the value of h statistic was also computed. When equation (1) was studied, the coefficient of adjustment varied from 0.323 to 0.618. Short run elasticity output with respect to price ranged from 0.007 to 0.219 while the value of long run elasticity of output varied from 0.021 to 0.428.

42. A Study on the Influence of Moist Days on Crop Production

By M. Gopinath Rao and P. N. Bhargava, *I. A. R. S., New Delhi.*

It has been recognised that the weather has a great influence on the crop production. Of all the other meteorological factors rainfall affects the agricultural operations and the planning of the cropping pattern most. In reference to rainfall the most important factor is the availability of water for the crop production in different phases of the crop growth. The availability of water is to be assessed by balancing rainfall against potential evapotranspiration and other water losses. Utilising the potential evapotranspiration and comparing them with the total rainfall the water availability period could be classified into three groups, namely, preparatory, intermediate and humid. The period is said to be preparatory if the rainfall is more than 1.10 of the potential evapotranspiration (PET) but less than equal to half of PET. It is intermediate if rainfall is more than half of PET but less than or equal to PET. If the rainfall is more than PET the period is said to be humid. The period covering intermediate and humid is called the moist period. In the present paper an attempt has been made to utilise the statistical methodology to study the various aspects of different types of water availability period defined above. For the present investigation the data of rainfall and PET for Jalgaon district in Maharashtra was utilised.

The study has suggested that the total number of moist and humid days in a year followed a normal distribution and the number of moist days yield have a high correlation. Further examination has suggested that for a normal yield about 30 moist days are necessary. If the moist days are below this minimum value the percentage loss in yield has also been worked out. For different number of moist days the recurrence period for one and two in succession have also been obtained.

43. **Determination of Optimum Sample Sizes for Different Auxiliary Characters in Multi-Phase Sampling**

By K. K. Tyagi and M. Rajagopalan, *I. A. R. S., New Delhi.*

In sample surveys it happens sometimes that several auxiliary variables are highly correlated with the variable under study. It is therefore of interest to investigate the effect of using all or some of them in building up an estimate of the population mean or total of the character under study. The cost of enumeration of units for each auxiliary character will be different for different characters. In some cases it may be very high and in some cases it may be very low. So it is not economical to collect information on all auxiliary characters for the same large sample because of varying degree of cost of enumerating different characters.

Ingram Olkin (1958) had discussed the extension of ratio method of estimation to the case where multi-auxiliary variables are used to increase precision. Here it is assumed that the population means corresponding to the different auxiliary variables are available before the sample is drawn. In this study, Multi-phase sampling is adopted and multivariate ratio and regression estimators of population mean Y are developed together with their biases and variances. It is found that the multivariate regression estimator is more efficient than the multivariate ratio estimator under some specific conditions.

Optimum sample sizes for different characters are determined by minimising the variance of improved estimators of the means of auxiliary characters.

44. **Double Sampling in Clusters of Unequal Sizes**

By S. J. Amdekar and B. B. P. S. Goel, *I. A. R. S., New Delhi.*

When clusters are of unequal sizes many estimation procedures are available. Among others these are: Unbiased and ratio estimators when sample is selected with equal probability, *pps* estimator when sample is selected replacement and with probability proportional to sizes of clusters and the inverse sampling method given by Sampford (1962).

The unbiased and ratio estimators require the knowledge of total number of elements in the population. Similarly in case the sample is to be selected with probability proportional to size all M_i 's must be known in advance. Cochran (1963) compared these

procedures under an appropriate mode and showed that when cluster means do not depend on cluster sizes ratio and *pps* estimators are better than unbiased estimator but when cluster totals are uncorrelated with cluster sizes it is the other way round.

So in order to employ unbiased estimators in such situations when knowledge of all M_i 's is required but not available, we can adopt the technique of phase sampling. A large sample of clusters can first be selected for estimating the mean/total number of elements in the population and then a sub sample of these are used to estimate the character under study. Estimators of population total and mean using two-phase sampling technique along with their variance expressions have been given. With the usual cost function appropriate to double sampling the optimum variances are obtained and the condition under which the two-phase estimators would be better than one-phase estimator have also been derived.

45. Estimation in PPS Sampling for Multiple Characters

By A. K. Srivastava and M. Srinath, *I. A. R. S., New Delhi.*

A basic requirement for the effective use of PPS method of selection is that the size measure which is used for selection should have high degree of linear relationship with the study character, the regression line passing through the origin. In large scale sample surveys where we are interested in estimating several characters with the help of a single sample, the auxiliary character used for selection may have a poor correlation with some of the study characters. Rao (1966) proposed several alternative estimators for this type of situation. A more general treatment of the problem was given by Pathak (1966). Practical situations are not uncommon, where auxiliary characters correlated to characters under study are available but they have not been used for making selections with the result that not all the study characters are highly correlated with the size measure used for selection. Some alternate estimators for this situation have been proposed. Their efficiencies have been compared with customary PPS estimators.

46. An Application of Principle Component Analysis For Estimating Total Vegetable Production

By A. C. Kaistha, *I. A. R. S., New Delhi.*

The total production of vegetables involve number of pickings. In the present paper it is attempted to study the contribution of

various pickings to the yield of various vegetables and investigate the possibility of estimating the total vegetable production through principle component analysis. The data collected under first round of vegetable survey in Bangalore district during 1971-72 have been utilised for this purpose.

47. An Application of Successive Sampling Procedure for Estimation of Milk Production

By S. K. Gupta and J. N. Garg, *I. A. R. S., New Delhi.*

The Institute of Agricultural Research Statistics has been engaged to evolve a suitable sampling methodology for simultaneous estimation of production of livestock products such as milk, eggs, wool and meat in a given region and to study changes in the level of production from season to season and year to year. This paper deals with the methods that could be employed for estimating production of milk and for studying changes from season to season within a year.

Production of milk per day per animal in milk was estimated for each cluster of villages in the sample by multiplying the number of animals of milk and the average milk yield per day per animal in milk. The sampling design adopted is treated as a unistage design with partial matching of units from season to season in a year.

The estimate of average milk production in a season was obtained by two methods. The first method was based on the data collected for each successive season after utilizing the previous season's information and the second method was based on the entire information available for the three seasons of the year. The comparison of the results showed that the second method (minimum variance unbiased estimator) was superior to the first method. The estimate of change from season to season was worked out by using the procedure of minimum variance unbiased estimate for change.

48. A New Method for Sampling with Varying Probabilities and without Replacement

By M. N. Deshpande, *Department of Statistics, Institute of Science, Nagpur.*

A new method for sampling with varying probabilities and without replacement is presented in this paper. The method possesses many advantages and is simple to implement. For this method

an unbiased estimator, which is similar to ratio estimators, is proposed. The expression of variance and estimator of variance are obtained.

49. A Study of Half-Sib Correlations and Parent-Offspring Correlation under Half-Sib Mating System

By K. C. George, *Department of Mathematics and Statistics, H. A. V., Hissar.*

The study of correlation between different inbred systems have been done by different authors such as Fisher (1918), Wright (1921), Kemthorne (1955), Horner (1956), Li (1957), Korde (1960) and George (1974). As the generation matrix in the case of half-sib mating are not easily possible, the study of the derivation of the joint distribution between half-sib pairs and the correlation therefrom are not attempted so far.

In this paper an attempt is made to derive the correlation table between half-sib pairs and parent offspring pairs, under different generations of half-sib mating and the correlations therefrom, assuming single locus with two alleles. The correlations are studied for one parent one offspring, one parent several offspring and both the parents several offspring cases. A comparative study of the correlations, numerically as well as graphically, were made. It is observed that in both parental case the correlations are of higher order than that of one parental case and in both the cases the correlation increases as the number of offspring increases. The limiting value of the correlation when the number of offspring tends to infinity is always unity in both parental cases in all the generations of half-sib mating, whereas it is less than unity in the initial generations and ultimately tending to unity when the number of generation increases.

50. Use of Ratio Estimator in Sampling over two Occasions

By Kishan Chand Goyal

The use of information obtained on previous occasion as auxiliary variable in forming the estimator on current occasion have attracted the attention of several authors. The theory of such estimators have already been developed to any number of occasions

using SRS and PPSWR sampling technique. In all these studies the basis of the estimator has been regression type. However, computational aspect of the regression estimator is laborious and time consuming. Moreover, as is usual in the absence of information on population regression coefficient, its estimator is used and thus the estimator ceases to be even unbiased. It is therefore felt that the substitution of Rati estimator for regression type estimator may not be out of tune.

In this paper, following the matching and unmatching technique on second occasion, the ratio estimator has been used for matched part and an independent estimator of population mean has been obtained by SRS mean from the unmatched portion. The variance of the optimum estimator (in the sense of mean square error) is given by

$$\frac{S^2 [n-u (2R\rho - R^2)]}{n^2 - (2R\rho - R^2)}$$

Optimum proportion of the number of units from the matched part is

$$\frac{\sqrt{1 - (2R\rho - R^2)}}{1 + \sqrt{1 - (2R\rho - R^2)}}$$

in which case the optimum variance comes out to be

$$\frac{S^2}{2n} \left\{ 1 + \sqrt{1 - (2R\rho - R^2)} \right\}$$

It is also noted that if the line of regression passes through the origin the variance of the estimator proposed here co-incides with the variance of the regression type estimator proposed by earlier workers.

Results can be extended up to h th occasion.

51. Iterative Sampling

By S. K. Agarwal, K. N. Kisra, *University of Jodhpur, Jodhpur (Raj.)* and A. K. Srivastava, *I. A. R. S., New Delhi-12.*

Haldane (1946) suggested a method of Inverse Sampling to estimate the proportion of rare attributes in a population. In this method the sample size is not fixed in advance. Sampling is continued until a predetermined no. of units possessing the rare attributes have been drawn. This may not be economical whenever the rarity is

considerably high, say one in thousand. This problem has not received much attention in the literature. The present paper deals with a new method in which a fraction of the population is extracted with the help of some auxiliary information. This fraction is expected to contain the attribute in a considerable quantity. This fraction later on generates the information about the presence of the attribute in the population. The procedure, thus, developed terminates in few steps giving an estimate of the population proportion. The number of stages for termination of the procedure depends upon the degree of the rarity of the attribute in the population.

52. On the Rao, Hartley and Cochran's Method of Sampling

By Lalit Kishore and R. Singh, *Punjab Agricultural University, Ludhiana.*

Rao, Hartley and Cochran (1962) have suggested a simple sampling procedure of selecting a sample with PPS without replacement. They have also proposed an unbiased estimate of population total for this scheme. For a given sample size this estimator is shown to be always more efficient than the usual-unbiased estimator in PPS with replacement sampling. Berg (1974) has tried to improve upon the estimator of Rao, Hartley and Cochran and in the process has suggested another estimator. This estimator is biased and inconsistent. This is, therefore, a serious disadvantage of the Berg's estimator and there is a need for unbiased estimators of the population total which are also more efficient than the Rao, Hartley and Cochran's estimator. In the present paper the authors have obtained two such estimates.

53. Record Statistics—A Review

By M. L. Aggarwal, *Department of Mathematical Statistics, University of Delhi.*

The feature of a sequence of observations which has attracted interest is the distribution of records. An observation is an upper (or lower) record if it is greater (less) than all the preceding observation. A record is a statistic and although record statistics entail some distribution-free results to the reached, they are primarily concerned with 'distribution dependent' techniques. Their distribution theory aims at analysing observed records and predicting occurrence of future ones.

Let X_1, X_2, \dots, X_n be a sequence of independent identically distributed random variables with common distribution function $F(\cdot)$. With $N_0=1$, we define

$$(1) N_a = \min\{j/j > N_{a-1}, X_j > X_{N_a}\}$$

$$(2) \Delta_a = N_a - N_{a-1}$$

$$(3) U_a = X_{N_a}$$

$$(4) \eta_u = \text{Number of upper records}$$

$$\{N_a\}, \{\Delta_a\}, \{U_a\}$$

and

η_u (η_l) has been studied by Chandler (1952), Foster and Stuart (1954), Renyi (1962), Neuts (1967), Tata (1969), Pickands (1971), Aggarwal and Nagabhushanan (1972, 74), Barr (1972), Shorrocks (1972 and 1973), Resnick (1973) and Yang (1975).

54. Sample Survey for the Estimation of Marine Fish Landings in India from Mechanised Fishing Crafts

By S.K. Dharmaraja and M.S. Prabhu, *Central Marine Fisheries Research Institute, Cochin.*

The mechanised finishing crafts of different types in India contribute to about 30% of the total marine fish catch of the country. The Central Marine Fisheries Research Institute had devised sample surveys methods for estimating the catches landed by both mechanised and non-mechanised fishing crafts. For the coverage of non-fishing crafts the Institute follows a stratified random sampling design and prepares month-wise estimates of marine fish production, both State-wise and species-wise. For the coverage of mechanised fishing crafts the Institute estimates the catch on a complete enumeration basis as well as by adopting suitable sampling scheme for covering large, medium and small type of fishing crafts. Pilot surveys were conducted to locate the landing centres where only mechanised boats operate during certain seasons. While in Maharashtra and Gujarat the mechanised boats operate from usual landing centres, in other States they operate mostly in centres where jetty facilities are available. The paper deals with the details of estimation procedure followed for the coverage of large, medium and small type of mechanised fishing crafts operating in the various maritime States of India.

55. Impact of Farm Size on Per Capita Income : A study in backward area based on important socio-economic indicators at Pimpalgaon in Nagpur District

By V. S. Kumat & M. V. Raut, *Indian Institute of Management, Ahmedabad.*

Poverty has been accorded high priority in new economic programme. Though the poverty and riches are relative terms, one tries to measure the poverty in terms of per capita consumption expenditure. In 1962, the Government of India recommended for capita consumption of Rs. 20 at 1960-61 prices per month as the base of minimum level of living in India which was later on changed to Rs. 40.00 at 1972-73 prices and also estimated that merely 30 percent of population in India lies below the poverty line. The Government is aware of this situation and has been endeavouring to narrow down inequalities in distribution of wealth and income with a view to ameliorating the condition of the poorer sections of the population.

In this paper an attempt has been made to evaluate the impact of farm size on per capita income based on socio-economic indicators in backward rural area.

56. Estimation of Acreage Response for Major Food Crops in Gujarat State

By A. K. Mishra, *Indian Institute of Management, Ahmedabad.*

The extent of farmers' response to change in price and price relationship is vital pre-requisite for any effective policy. It has got a wide range of analytical and practical significance including the problem of public finance and of price and income stabilisation.

Ideally, supply response study establishes some kind of relationship between expected price and planned output of a crop. Nerlove (17) was the first person who made an attempt to formulate the theory lying behind its phenomenon. Subsequently, many other researchers namely Moore (16), Smith (23), Bean (3), Walsh (25) studied this problem relating either acreage or production to the prices lagged by one year. Beans was first to introduce price of competing crops in his analysis.

5. Analysis of a Special Type of Split-Plot Design

By K.R. Aggarwal and Sucha Singh, *Punjab Agricultural University, Ludhiana.*

Let us consider a split plot design with pb main-plots, t sub-plots within each main-plot and r blocks. Let pq treatment combinations of a $p \times q$ factorial experiment in factors N and P be allotted to the pq main-plots. Further let t methods of application of fertiliser be taken as the t sub-plot treatments. Let 00 represent control indicating zero dose of fertilisers N and P . Then all the t sub-plots in the main plot to which the 0 is allotted will get repeated t times. Thus, in all, there will be $(pq-1) \times t + 1$ distinct treatments in the design for which analysis is wanted. This paper contains the analysis of this special type of Split-plot design. Let E_a and E_b be the error mean squares for error (a) and error (b), respectively as defined in Cox and Cochran (1957), p. 298 (Experimental Designs). The estimate of standard error for the difference between the control mean and any other sub-plot treatment combination mean is $\sqrt{(2E_a + (t-1)E_b)/r}$. The estimates of the other standard errors are as reported in Cox and Cochran (1957), p. 298 (Experimental Designs).

6. A Class of Change-over Designs Balanced for First Residual Effects

By A. Dey and G. Balachandran, *I.A.R.S., New Delhi.*

Designs in which each experimental unit receives a cyclical sequence of several treatments in successive periods are known as change-over designs. A change-over design, permitting the estimation of residual effects is called balanced, if the variance of any elementary contrast among the direct effect estimates is a constant, say α and variance of any elementary contrast among the estimated residual effects is a constant, say β . The constants α and β need not be equal. However, if $\alpha = \beta$, the designs may be called totally balanced. Using a series of BIB designs, a class of balanced change-over designs are constructed. These designs are totally balanced for the first residual effects in the above sense. A list of useful designs along with their efficiency factors is also provided. The efficiency factors of these designs are seen to be fairly high.

7. On some useful Chemical Balance Weighing Designs from Family (A) Balanced Incomplete Block (BIB) Designs

By S.C. Gupta, *Department of Mathematical Statistics, University of Delhi, Delhi.*

And

M.N. Das, *National Sample Surveys Organisation, Faridabad.*

The results of n weighing operations to determine the weights of p light objects fits into the linear model $\underline{Y} = \underline{X} \underline{\beta} + \underline{\epsilon}$, where \underline{Y} is the $n \times 1$ observation vector, $\underline{X} = (x_{ij})$, $i=1, \dots, n$; $j=1, \dots, p$ is an $n \times p$ matrix of known elements, $\underline{\beta}$ is the p -component column vector of unknown weights and $\underline{\epsilon}$ is a $n \times 1$ random vector of errors with $E(\underline{\epsilon}) = \underline{0}$ and $E(\underline{\epsilon} \underline{\epsilon}') = 2I_n$. In a chemical balance problem x_{ij} assume values $+1$, -1 and 0 according as the j th object is placed in the left, right or neither pan in the i th weighing respectively. The problem of estimation of weights of a number of light objects has been dealt with quite extensively in literature. Raghav Rao (1959) has given a number of optimum chemical balance plans. Dey (1971) has shown that family (A) BIB designs afford optimum designs for the chemical balance problem.

A design for weighing p objects in n weighings is said to be optimum if the each of the weights is estimated with variance σ^2/n . We shall introduce a more general definition of an optimum design. Consider a design \underline{X} for weighing p objects in n weighing operations where the i th object is included in the weighing operation n_i ($i=1, \dots, p$) times. Then we shall say that the design \underline{X} is optimum for the above-mentioned scheme if the weight of the i th object is estimated with variance σ^2/n_i ($i=1, \dots, p$). Hereafter we shall use the term optimum in the latter sense.

The question raised here is "How to obtain chemical balance designs when one is interested in more precise estimates on a fraction of objects to be weighed?". The authors have suggested a technique for combining two family (A) BIB designs which can be used to obtain optimum estimates with at most three types of variances. A large number of useful designs suitable to one's need may be constructed using this technique. The method is easily generalized to the case when one can combine a number of family (A) BIB designs.

8. Optimality of Experimental Designs-I

By M. Singh and A. Dey, *I.A.R.S., N. Delhi.*

G-optimal designs for regression problems have been defined by Kiefer and Wolfowitz (1959). This paper is concerned with the G-optimality criterion for Second Order Rotatable Designs. Tables of G-efficiencies for various designs is presented. A method of constructing G-optimal Second Order Rotatable Designs is also given.

9. Evaluation of Status of Experimental Research in Animal Nutrition

By B. Marutiram, S. N. Bajpai and G. C. Chawla, *I.A.R.S., N. Delhi.*

A quantitative assessment of the progress of research in any field in the country indicates the manner and the extent to which the resources of the country in respect of research-workers, funds and other facilities are being utilised for the solution of the most important problems facing the country and provides useful information on the efficiency of methods adopted in investigating these problems. With this object in view, the experiments conducted in the field of animal nutrition at one of the premier research institutes in the country during 1945-70 were valued and various aspects of this valuation with reference to designing and conduct of experiments are presented in the paper. A scoring technique of analysis was adopted to quantitatively assess the amount of information contained in these experiments on different treatments. A comparative study of the amount of information that could have been obtained through proper choice of treatment combinations and designing of experiments was made. An attempt was also made to obtain the extent of loss of information. The shortcomings in the selection of treatments to be tested and the lay out of the experiments were also indicated.

10. A Modification in the Estimation Procedure in Dilution Series

By Murari Singh and A. Dey, *I.A.R.S., N. Delhi.*

The effect due to miscounting on the estimate of very low bacterial density in dilution series has been studied. Due to this discrepancy, the distribution of number of organisms per sample is

seen to be Inflated Poisson Distribution. The estimate of density of bacterial suspension has been obtained along with its standard error. The estimate of inflation parameter has been also worked out along with its variance.

11. Concentration Ratio in Milk Production

By K.C. Raut, *I.A.R.S., N. Delhi.*

Study on the production potentialities of milch stock in different orders of lactation can help in formulating improvement programmes on sound lines. Attempts have been made to study concentration in milk production of buffaloes maintained under village conditions utilising data collected in a large scale sample survey carried out in Dhulia region of Maharashtra. The concentration ratio has been worked out with the help of Lorenz curve to measure and compare the inequalities in milk production pattern for buffaloes in different orders of lactation. The study indicated that among the first to fifth orders of lactation, the concentration in milk production was highest for buffaloes in third order of lactation and minimum in first and fifth lactations.

12. Profitability of Milk Production in Different Categories of Rural Households

By K. C. Raut, Shivtar Singh and R. L. Rustagi, *I.A.R.S., N. Delhi.*

Steps are being taken to improve the economic status of farmers as well as of landless cattle owners. Study of the comparative economics of milk production by landless cattle owners and farmers of small, medium and large holdings will help in drawing developmental programmes on sound lines. The cost of production of milk in different categories of producer-households has been worked out along with the level of production utilising data collected through a large-scale sample survey carried out by the Institute of Agricultural Research Statistics in Dhulia region of Maharashtra. Among the households having bovines, 10.5 per cent were landless, 53.2 per cent possessed land up to 4 hectares, 24.9 per cent had land between 5 to 8 hectares and 11.4 per cent owned land more than 8 hectares. The number of bovines in a household increased with the size of holding. It was estimated that the cost of production of buffalo milk was

minimum for landless cattle owners and maximum for small farmers. Similar was the trend for the maintenance cost of a milch buffalo in different categories of households. For small farmers the production cost including family labour equalled the prevailing market rate of milk and in other categories of households the production cost was less than the market rate.

13. A Note on the Unbiased Regression Estimate

By Randhir Singh, *I.A.R.S., N. Delhi.*

In sampling theory, the use of some auxiliary variable considerably improves the precision of the estimates for the character under study. The use of ratio and regression methods of estimation is very frequent in sample surveys when \bar{X} , the population mean for the auxiliary variable is known. But both these methods provide biased estimates.

In the present investigation a simple unbiased regression type estimate has been proposed in the case when the auxiliary information is available for every unit in the population. The efficiency of the proposed estimate has been compared with the usual regression estimate with the help of actual data.

14. Use of Principle Component Analysis for Estimation of Production of Berseem Crop

By Anand Prakash & D.K. Agarwal, *I.A.R.S., N. Delhi.*

The estimation of production in case of Fodder Crops is complicated by the fact that fodder is sometimes harvested in instalments and in case of some fodder crops repeated cuttings are taken. With such crops, crop cutting experiments are to be conducted at each stage of growth thus increasing the work and observations considerably. To get over this difficulty, in this paper an attempt is made to use principal component technique to explore the possibility of estimating the production of berseem crop based on smaller number of observations. It has been found that first five new variates account for 92 per cent of the total variance in the set of all observations in berseem crop and the first four contributes about 79%.

15. Efficiency Balanced Designs

By P. D. Puri, *Haryana Agricultural University, Hissar.*

A design is said to be Efficiency Balanced (EB) if all contrasts are estimated with same efficiency [Calinski (1971); Biometrics and Puri and Nigam (1975); J. R. S. S. (B)]. Puri and Nigam (1975 Sankhya) have given a systematic procedure of construction of these designs in varying replicates.

John (1964, A. M. S.), Kulshreshta et. al. (1972, A. M. S.) and Hedayat and Federer (1974, Inst. Stat. Math.) have constructed variance balanced designs with unequal block sizes and varying replicates by using two BIB designs with same number of treatments. In the present note we have extended their method to construct the EB designs in varying replicates and varying block sizes. The EB designs constructed through this procedure are likely to be useful, as the number of experimental units required for EB designs are much less as compared to variance balanced designs constructed by Hedayat and Federer (1974).

16. Trace-Optimal Balanced 2^{10} Reduced Designs of Resolution V, $56 \leq N \leq 65$.

By D. V. Chopra, *Wichita State University, Wichita (U. S. A.).*

In this paper we present a series of fractional factorial designs (F. F. D.) for 2^{10} series when the number of runs (or treatment-combinations) N satisfies $56 \leq N \leq 65$. The following are the features of the given designs:

- (i) Each is of resolution V i.e. it allows us to estimate effects up to two-factor interactions when higher-order interactions are assumed negligible.
- (ii) Each is balanced, i.e. the covariance matrix is invariant under a permutation of the factor symbols.
- (iii) Each design is trace-optimal.

It is well-known that a F. F. D. of resolution V for 2^m series with N runs is identical with a balanced array (B-array) of strength four defined as follows: A B-array T of strength four with two symbols is a matrix T ($m \times N$) with elements (say) 0 and 1 such that every $(4 \times N)$ submatrix T_0 of T will have each (4×1) vector with i 1's

($i = 0, 1, 2, 3, 4$) appear μ_i times. We call $\mu = (\mu_0, \mu_1, \mu_2, \mu_3, \mu_4)$ the index set of the B-array. For each N satisfying $56 \leq N \leq 65$, we list those values of μ' with the minimum trace. Finally, for the ease in analysis all the elements of the covariance matrix for each design are also included.

17. Trends in the Yield Rates of Various Food Crops in Uttar Pradesh during First Three Five-Year Plans

By B. V. S. Sisodia & S. C. Rai, *I.A.R.S., New Delhi.*

The trends in yield rates of four important crops, Rice, Maize, Wheat and Gram in Uttar Pradesh during the first three Five-Year Plans have been studied. The data on yield rates have been analysed for the year 1950-51 to 1965-66. The main interest of statistical analysis undertaken in the study was the comparison of quinquennial average yield of these crops in different divisions and the State as a whole for the pre-plan (1950-51), first plan (1951-52 to 1955-56), second plan (1956-57 to 1960-61) and third plan (1961-62 to 1965-66). The results showed that increase in the yield rates of Rice for the State as a whole was highest during the second plan, being about 123 kg/ha (about 21 per cent) as compared to the corresponding control period. The corresponding increase of 50 and 50 kg/ha were observed during first plan and third five-year plan. As far as concerned with trends in yield rates of Maize, the results lead to the conclusion that there was no sign of impact in any five-year plan periods for the State as a whole. The increase in the yield level of Maize for the State as a whole in the third plan was about 62 kg/ha whereas the same in the first plan was 23 kg/ha while 61 kg/ha was depression in the second plan period compared to the first plan.

In case of Wheat, it is observed that third Five-Year Plan was having better impact on the yield rates as compared to other Five-Year Plans taken under study. The increase in the yield rates of Wheat during the first, second and third plans were obtained about 7, 8 and 69 kg./ha respectively. As far as the yield of Gram is concerned, it may be concluded that there was no proper impact of any Five-Year Plans at the State level.

18. Trend of Production of Foodgrains in India

By R. Balakrishnan & S. D. Bokil, *I.A.R.S., New Delhi.*

The trend is studied by measurement of growth rate of output of production of foodgrains during the period 1949-50 to 1972-73 and

1954-55 to 1972-73, the latter period corresponding to post-reorganisation set up of States. Both linear and compound growth rates have been worked out for total foodgrains as well as for the crops Rice, Bajra, Jowar, Maize and Wheat at All India level and for Rice, Wheat and total foodgrains for some States.

It is found that the growth rate of production of foodgrains at All India level is not adequate to keep pace with the growth of population and even a marginal increase in per caput demand. Even amongst the crops only Wheat is showing satisfactory growth rate of output, with significant increase in the growth rate in the post-HYV period *i.e.* 1967-68 onward. There is considerable variation in the performance of States, the Punjab, Haryana, H. P. region showing the highest growth rate.

19. Economics of Marketing of Apples in Hilly Areas of Uttar Pradesh

By B. L. Kaul & A. H. Manwani, *I.A.R.S., New Delhi.*

In this paper attempt has been made to estimate returns and marketing costs of apples grown in Nainital, Almora, Uttar-Kashi and Tehri regions of Uttar-Pradesh. The data used for this investigation have been taken from a comprehensive survey conducted by I. A. R. S. for determining the cost of cultivation and marketing of apples in hilly regions of U. P. during the year 1974. According to this study, it has found that the average gross sale price of half case of 8 kg. apple was Rs. 24.35 for the entire region as a whole. The maximum price of Rs. 25.78 per half case was for consignments despatched from Uttar-Kashi and the minimum of Rs. 18.46 was of consignments despatched from Nainital. The price varied from variety to variety. The minimum was Rs. 15.26 for half case of Rymer-Buckingham varieties of apples mainly grown in Nainital and Ranikhet regions, and the maximum was Rs. 28.97 for half case of Royal delicious varieties mainly grown in Uttar-Kashi region. The total marketing charges formed about 25.26 per cent of the gross average price received by the Orchardist of which nearly 50% was on account of packing and the rest was more or less equally distributed to transport and commission etc. Thus, on an average, the orchardist received a net return of Rs. 1.72 per kg. in Nainital and as much as Rs. 2.62 per kg. in Uttar-Kashi. The main reason for the higher prices received by Uttar-Kashi Orchardist was due to

the fact that more than 55 per cent of the apple marketed from this region was of Royal delicious variety as compared to 1.3 per cent of this variety despatched from Nainital. The net returns were also found to vary from market to market. Detailed analysis on returns and marketing charges has been carried out for 17 different markets where apple from the region was despatched.

20. Estimation of Milk Production and its Utilisation and Feed Consumption in Bovines Around Karnal.

By K. N. S. Sharma & S. B. Agarwal *National Deiry Research Institute, Karnal*

This paper presents the results of the survey conducted to estimate the milk production and bovine development, around Karnal. The design of the survey was two—state satisfied sampling. The villages within 12 miles radius around Karnal was divided into two strata (i) Key village area and (ii) Non key village area, (Villages not included in any of the developmental projects of State/Centre). Six village were selected independently in each of the three seasons (*viz.* (i) Rainly season July to October, (ii) Winter season, November to February and (iii) Summer season March to June) from each stratum. Four households were selected from each of the selected villages every fortnight during the first year of the survey and six households during the second year of the survey. The survey was conducted from July, 1972 to June, 1974.

The average milk production per cow per day in milk was 2.80 kg. in stratum I and 2.85 in Stratum II. The overall milk yield per cow per day was 1.42 kg. and 1.42 kg. in both the strata. The percentage standard errors were 7.58 and 9.76 for cows in milk and 8.87 and 11.76 for overall milch cows. The average milk per buffalo per day in milk was 4.40 kg. in Stratum I 14.24 kg. in stratum II and overall milk production per milch buffalo was 2.46 kg. and 2.41 kg. respectively. The percentage standard errors were 7.41 and 7.84 for buffalo in milk and 7.51 and 8.34 for overall milch bufaloes. The differences between stratum I and stratum II were not significant in both cow and buffalo. This may be due to the nearness of the villages to the institute an operation of I. C. D. Projects around Karnal,

The feeds fed per cow per day were 20.29 ± 1.74 kg. green fodder, 5.60 ± 0.60 dry fodder and 0.076 ± 0.023 kg. concentrates when in milk. The overall feeds fed per milch cow was 19.65 ± 1.69 kg. green fodder, 5.97 ± 0.55 kg. dry fodder, and 0.054 ± 0.020 kg. concentrates in Stratum I. Similar figures for Stratum II were 18.57 ± 1.80 kg. green fodder, 5.19 ± 0.65 kg. dry fodder, and 0.053 ± 0.020 kg. concentrate for cows in milk and 18.00 ± 1.61 kg. green fodder, 5.26 ± 0.50 kg. dry fodder, and 0.061 ± 0.017 kg. concentrates respectively.

The feed consumption per buffalo per day when in milk was 26.53 ± 2.57 kg. green fodder, 8.87 ± 0.66 kg. dry fodder and 0.305 ± 0.049 kg. concentrates; for milch buffaloes 25.42 ± 1.19 kg. concentrates; for milch buffaloes 25.42 ± 1.91 kg. green fodder, 8.36 ± 0.71 kg. dry fodder and 0.161 ± 0.035 kg. concentrates in Stratum I. Similar figures for Stratum II being 26.11 ± 1.97 kg. green fodder, 6.62 ± 0.66 kg. dry fodder and 0.162 ± 0.041 kg. concentrates for buffaloes in milk; 25.14 ± 2.45 kg. green fodder, 6.81 ± 0.64 kg. dry fodder and 0.147 ± 0.026 kg. concentrates for milch buffaloes.

Generally group feeding was followed and hence the estimates of feed consumption for animals in milk and overall milch animals were of the same order.

Seasonal differences both in milk production and feed consumption were observed. The milk production was highest in summer season followed by Winter and Rainy season. The green fodder availability was more in rainy season followed by winter and summer. However, it was observed that the total dry matter availability was less in summer season. The quality of the green fodder fed in summer and rainy season, was mostly of poorer quality through the quantity was more, while in winter the green fodder consists mainly of Berseem.

The percentage utilisation of milk was 29.9% as fluid milk, 42.9% as conversion into products and 27.2% available for sale. The marketed surplus of milk differed from season to season, it was highest in rainy season followed by winter and summer season. Nearly 43 percent of the milk produced was convert into products. There is possibility of increasing the marketed surplus by offering marketing facilities and price incentives,

21. A Study on the Variation in the Chemical and Bacteriological Quality of Milk Procured by Milk Dairy Plants

By Bhupal Singh, K. N. S. Sharma & M. R. Srinivasan,
National Dairy Research Institute, Karnal.

This study attempts to bring out the regional and seasonal variations in the chemical and bacteriological quality of milk based on the data collected in the All India Coordinated Research Project on Cost of Chilling and Transportation of Milk to city dairies. The four dairies covered were, Hyderabad in the South, Mehsana in the West, Cuttack in the East and Gauhati in the North-Eastern region. 5,280 and 2,913 samples of buffalo milk from the primary milk suppliers from Hyderabad and Mehsana, 260, 3,571 and 2,080 cow milk samples from Hyderabad, Cuttack and Gauhati respectively were analysed.

Buffalo milk samples from Mehsana were observed to contain more fat and SNF (7.14 and 9.42) percentages than Hyderabad (6.49 and 9.74). Winter samples (Nov. to Feb.) showed lowest fat percentage and summer samples (March to June) highest whereas rainy season samples (July to Oct.) lying in between the two in Mehsana. The SNF percentage however did not show much seasonal variation, though summer samples contained slightly higher SNF level. The seasonal variations, in fat percentages could not be detected in the samples from Hyderabad. The SNF content of summer samples was observed to be lower while those of winter and rainy seasons being similar.

The average fat and SNF percentages of cow milk samples were 4.53 and 8.45 in Hyderabad, 4.50 and 7.54 in Cuttack and 3.80 and 7.12 in Gauhati. Gauhati showed significantly lower fat and SNF percentages than the other two centres. The fat percentage of summer samples from Hyderabad and Cuttack were observed to be lowest and rainy season samples gave highest fat and SNF percentages. The SNF percentage was also highest in the rainy season in these two centres. In all the centres and in all the seasons fat percentage was observed to be much below 8.0%, except in the rainy season in Hyderabad and Cuttack. Gauhati did not record any variation in fat percentage. The SNF percentage was highest in winter,

The percentage acidity was found to be significantly highest in Hyderabad and Cuttack regions (0.172 and 0.179 percent respectively)

compared to Mehsana and Gauhati (0.136 and 0.131 percent respectively). The average M. B. R. time was 117 minutes in Hyderabad, 42.52 million in Mehsana, 61.7 million in Cuttack, 112 minutes in Hyderabad, 84 minutes in Gauhati and 68 minutes in Mehsana. The SPC was 57.0 million in Cuttack and 44 million in Gauhati. No seasonal variations were observed in the percentage-acidity. Winter samples showed generally higher MBR time, compared to other seasons. However, the SPC was higher in winter months. No consistant results were observed for bacteriological quality. This may be due to lack of facilities for the analysis of samples and also transporation of the samples from procurement point to central laboratory.

22. Effect of Age at First Calving on First Lactation Yield

By K. C. Raut & Shivtar Singh, *I.A.R.S., New Delhi.*

Any study attempting to find out the factors influencing milk production will help in formulating production plans on efficientlines. It may form one of the basic criteria of selection in breeding programme. The effect of the age at first calving on first lactation yield of buffaloes maintained under village conditions has been studied utilising data collected in large scale sample surveys carried out in Hissar (Haryana), Krishna delta area (Andhra Pradesh) and Dhulia region (Maharashtra). The average age at first calving of a buffalo was 48.6 months in Hissar district, 57.6 months in Krishna delta area and 60.8 months in Dhulia region. The first lactation yield of a buffalo was estimated to be about 1,588 kg., 625 kg. and 1,158 kg. in these three areas respectively. The study of the relationship between these two characters showed that late calving would result in decrease in first lactation yield.

23. On Partially Balanced Incomplete Block Designs through Partially Balanced Ternary Designs

By S. K. Mehta, *Punjab Agricultural University, Ludhiana,*
S. K. Aggarwal *University of Jodhpur, Jodhpur,*
and A. K. Nigam, *I. A. R. S., New Delhi.*

Generalising the concept of balanced n-ary designs we have defined partially balanced n-ary designs. Partially balanced ternary

designs can be constructed through PBIB designs so that the type and order of the association scheme in the partially balanced ternary design remains unchanged. Using the properties of partially balanced ternary designs and linked block designs, some new methods of construction of certain series of Group Divisible and Triangular PBIB designs have been presented.

24. On Some Incomplete Block Designs for Multiple Symmetrical Parallel Line Assays

By A. C. Kulshreshtha, *Central Statistical Organisation, New Delhi.*

When several test preparations are to be assayed against the same standard preparation then multiple assays are preferred because they permit more economical use of experimental subjects and the regression coefficient is more precisely determined from the combined evidence of all subjects. In multiple symmetrical parallel line assays all the 'preparation' and 'combined regression' contrasts are of major importance as all these are used in the estimation of relative potencies of various test preparations.

In the present paper four useful series of incomplete block designs for multiple symmetrical parallel line assays are presented. The proposed designs provide full information on all the contrasts of major importance. The construction and analysis for the proposed designs are discussed.

25. Inbreeding in Sahiwal Herd and its Impact on Economic Characters

By Dharmendra Kumar, *Directorate of Animal Husbandry, U.P. Lucknow,* and Prem Narain, *I. A. R. S., New Delhi.*

The inbreeding coefficient of Sahiwal cows maintained at Livestock Farm Chak Ganjaria was worked out tracing the pedigree of the cows born in 1972 at the farm. Out of 164 cows only 83 cows were found to be inbred. Considering the pedigree up to 5 previous generations, the overall inbreeding coefficient worked out to be 9.6% ranging from 1% to 27%.

For studying the effect of inbreeding on various economic character the regression equations were fitted. The fitted equations

in respect of lactation yield, lactation period and calving interval are given below :—

<i>Characters</i>	<i>Fitted Equation</i>
1. Lactation yield	$Y=1497.20-1415.73x+947.64 x^2$
2. Lactation period	$Y=286.9541-57.8435x-1632.5977 x^2$
3. Inter-calving period	$Y=421.61+129.57x+626.69 x^2$

On the basis of the above equations the impact of adverse effect on these characters were worked out and have been predicted in the quantitative terms. The lactation yield and lactation period was found to decrease by about 20% and 47% whereas inter-calving period was estimated to increase by 19% in the inbred cows having 27% inbreeding coefficient as compared to those having 1%. Further, it was also concluded that significant cumulative adverse effect of inbreeding in the herd was observed after 4%. Hence, in order to avoid further inbreeding which adversely affect on vigour and reproductive performance of the herd immediate steps need to be taken to bring fresh blood from outside, so that further deterioration in the herd can be avoided.

26. On Random Non-response in Sample Surveys

By Ravindra Singh, *Punjab Agricultural University, Ludhiana.*

Certain concepts have been defined for the estimates in presence of random non-response. A comparison between the estimates of population total for the unequal probability with replacement sampling and the 'Rao, Hartley and Cochran's (1962) scheme of sampling' has been made with regard to the above concepts. For this comparison, the sample size has been assumed to be the same in two selection procedures.

27. Optimum Probability Set for Ikeda-Sen's Sampling Strategy

By A. M. Pedgaonkar & S. G. Prabhu Ajgaonkar, *Department of Mathematics and Statistics, Marathwada University, Aurangabad-431002.*

Midzuno (Ann. Inst. Stat. Math. 1 : 1950) suggested an estimate which belongs to Horvitz and Thompson's (Jr. Amer. Stat. Assoc. 47,

1952) T_3 -class of linear estimators. This T_3 -class of linear estimators has been examined by Prabhu-Ajgaonkar (Metrika 12, 1967) and was noted that a best estimator does not exist for the T_3 -class. Godambe (Jr. Royal Stat. Soc. 28, 1966) considering a new approach to sampling from finite populations, demonstrated that for any fixed sample size design, the only unbiased estimator of the population total which is linearly sufficient and which satisfies the principle of censoring belongs to the T_3 -class. An attempt has been made in the present paper to determine an optimum probability set for Ikeda-Sen's sampling procedure when Midzuno's estimator belonging to the T_3 -class is employed for this purpose the "Bayesian Technique" is used.

28. A Study on the Non-response in Two Characters in a Two Stage Design

By R. P. S. Malik, *Agro Economic Research Centre, H. P. University, Simla-5 (India).*

In sample survey practice, non-response from some of the sampling units is of common occurrence. If the non-response is considerable, the estimates obtained on the basis of realised sample may not represent the true characteristics of the entire population.

Various attempts have been made to develop a suitable plan of enquiry, which will take both bias and the cost of the survey into consideration whenever a problem of 'non-response' arises. The problem has been attempted by several workers and various methods have been suggested to minimise or eliminate bias by having 'Call-backs' on the non responding units once or more than once. Alternate method suggested to achieve this aim is to devise a suitable plan of enquiry to reduce the non-responding group to the barest minimum. Most of the work that has been done in this direction deals with single stage sampling and with one character under study. The present paper deals with the problem of non-response in two stage sampling design and with two characters under study. The procedure consists in classifying the first sample of PSU's into 15 strata on the basis of information supplied by SSU's. The final sample of SSU's is again classified into four classes according to the information supplied by them. Estimates of population means for both the characters along with their variances have been worked out. The optimum values have been calculated by using non-linear programming method and also by method of weights.

29. On the Sample Size Determination in Multivariate Case

By Rajinder Singh.

The problem of sample size determination is one of the important factors in sample surveys. The problem has been studied in detail by various authors [See Murthy (1967), pages 113-123], for a single study variable and when different forms of apriori information is available. But this problem becomes more complicated when there are multiple characters or study variables. Because for different apriori variables different information may be available. In such case one can make use of the variance covariance (dispersion) matrix of the variables and apply some optimality condition to it, in order to arrive at a single compromise sample size for all variables. In the present paper D-optimality [See Raghavarao (1971), page 315] condition is discussed to solve the above problem.

30. Positive Assortative Mating with Selection Against Recessives

By Subash Chandra and M. Rajagopalan, *I. A. R. S., New Delhi.*

Wright (1921) found that assortative mating leads to the greatest diversification of the population as a whole. In the absence of selection this mating leads to increased variability in the population. Breese (1956) also found a significant increase in the genetic variability under this system of mating as compared with that found under random mating. This significant increase in the genetic variability suggests that assortative mating may be widely used as a technique in plant or animal breeding especially where inbreeding methods are impracticable or undesirable. The object of the present paper is to get expressions for gene frequency, genotypic frequencies and genetic variance in successive generations of complete positive assortative mating when selection is applied against homozygote recessives. A single locus case has been considered. The expression for gene frequency at time 't' has been obtained as

$$\frac{1}{P_t} = s + \frac{1-s}{P_{t-1}} + \frac{s \lambda_0}{1+(t-1)\lambda_0}$$

that of genotype frequencies as

$$P_t = P_t (1 - \lambda_{t-1})$$

$$2Q_t = 2P_t \lambda_{t-1}$$

$$R_t = 1 - P_t (1 + \lambda_{t-1})$$

The present study is an attempt (i) to estimate the response to changes in price and price relationship and (ii) to estimate the short-run and long-run elasticities of supply (acreage) of agricultural commodities derived from time series data for the Gujarat State. The main purpose of this study is to gauge the relations of price changes on the farmers' decision to allocate land to different crops.

In this paper, we have used the dynamic model of supply because of its superiority over the 'conventional' static approach, in the theory of economic behaviour. The model is based on the generally accepted notion that current decisions are influenced by experience relating to past decision or past behaviour which can be specified econometrically by the theory of distributed lags. It is also argued that the use of short-run elasticities for long-run projections results in a built-in inconsistency. We have confined our study for main food crops only namely Paddy, Wheat and Bajra.

57. Stratification for a Two-stage Design

By P. C. Gupta & N. Srivastava, *Rajasthan University, Jaipur.*

The optimum stratification for a unistage design has been discussed at length by Singh (1968). He has further obtained the optimum points of stratification when the stratifying variable is also used for building ratio, product and regression estimates. The problem of optimum stratification for more than one character has been discussed by Ghosh (1963), Seth and Gupta (1968) and Gupta (1970). The optimum boundary points, when stratifying variable is used for building ratio, product and regression estimates when more than one character is under study, was given by Gupta and Seth (1969) and Gupta (1972).

The present study deals with the problem of optimum stratification for a two-stage design. Stratifying on the character itself, under proportionate allocation, the optimum boundary points have been obtained and they behave similar to unistage one. Optimum stratification based on an auxiliary character have been also investigated. The use of ratio, product and regression methods of estimation in stratification for two-stage design has also been obtained.

58. A Note on Minimum Variance Linear Unbiased Estimators in Multistage Sampling Design on Successive Occasions

By C. L. Agarwal and B. D. Tikkiwal, *Rajasthan University, Jaipur.*

The two-stage successive sampling is mainly developed by Tikkiwal (1958, AMS; 1964, Sankhya Ser. A; 1965, J. Ind. Stat. Asso.); Singh (1968, JASA), Singh and Kathuria (1969, Aust.), J. Sat. Abraham, Khosla and Kathuria (1969, JISAS), Kathuria and Singh (1971, JISAS) and Srivastava and Shivtar Singh (1974, JISAS) to estimate the population mean on the current occasion under certain restrictive assumptions. Agarwal and Tikkiwal (1975, Proceedings of the 62nd Session of Indian Science Congress Association) have obtained the minimum variance linear unbiased estimator (MVLUE) of the population mean on the h th ($h \geq 2$) occasion under less restrictive assumptions. The present paper extends the results to multistage successive sampling. It is shown that the forms of the MVLUE and its variance remain the same when the units are replaced at some one stage only.

59. The Impact of Unordering and Combined Unordering of Estimators on T-Classes of Linear Estimators

By N. K. Bhargava.

Tikkiwal (1972) gave a general technique of unordering an ordered estimator for sampling with or without replacement and that of combined unordering for sampling with replacement. It is shown in this paper that the applications of the above techniques to different estimators in different T-Classes enables to obtain various new results, in addition to those given by Basu (1958) and Pathak (1964) by a different method based on the concept of sufficiency in survey sampling. For this, first a general discussion, regarding unordering and combined unordering, is given for each of the seven T-Classes. After this, special cases, wherever possible, in each class, are discussed in detail. By detailed investigation, it is shown that the seven T-Classes of linear estimators, by unordering wherever necessary, reduce to three effective classes namely T_2 , T_3 and T_5 . It is further shown that the application of the technique of combined unordering, wherever possible, does not alter the effective number of classes.

60. A Review of Unordering and Combined Unordering of Estimators for Sampling with or Without Replacement

By N. K. Bhargava.

Murthy (1957), for sampling with varying probabilities without replacement gave a general technique of unordering an ordered estimator based on an ordered sample to get an improved estimator, in the sense of efficiency, over each of that based on different ordered samples s_1 containing the same set of units. Tikkiwal (1972) gave a unified approach for unordering an ordered estimator when there is sampling with or without replacement from which Murthy's results follow as a special case. He has further discussed the technique of combined unordering for sampling with replacement. This paper gives a detailed review of the above work including that of the author on Unordering and Combined Unordering.