

ABSTRACT OF PAPERS FOR 34TH ANNUAL CONFERENCE OF ISAS

1. On the Class of Nearly Best Strategies Using Auxiliary Information

BY P.C. GUPTA, DHIRESH ADHVARYU AND R.T. RATANI

South Gujarat University, Surat

Some alternative strategies using auxiliary information were studied by Advharyu and Gupta (1980). They suitably combined, taking two at a time, the usual mean per unit estimate, ratio and product estimators. In this paper all the three estimators have been combined and the normalised optimum weights are obtained. The resultant strategy has a zero variance to first degree approximation and is then transformed into another strategy which is also unbiased to the same degree of approximation.

2. On Non-Existence of Necessary Best Estimator in $T_{5(t)}$ -Class of Linear Estimators for Sampling With and Without Replacement

BY G.C. TIKKIWAL

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Bhargawa and Tikkiwal (1978), incorporating the previous work of Tikkiwal (1960) and Tikkiwal and Ajgaonkar (1961), proposed the modified set of seven T -classes of linear estimators after examining the set of axioms due to Koop (1963). The modified set of seven T -classes is wider in nature, in as much as all earlier T -classes are either same or lie in sub-classes of some of these seven classes. In this connection Bhargava and Tikkiwal proved that the T_2 -class of linear estimators due to Godambe (1955) and Koop (1963), T_3 and T_5 classes of linear estimators due to Koop (1963) lies in their $T_{5(t)}$ -class of linear estimators. Therefore $T_{5(t)}$ -class is wider in nature. Yogi and Gupta (1975) proved the non-existence of second and higher order Necessary Best Estimator (NBE), a criterion proposed by Ajgaonkar (1965), in T_3 and T_5 class of linear estimators, given by Koop (1963), for sampling without replacement. This paper examines the existence of NBE in $T_{5(t)}$ -class for sampling with and without replacement.

3. Usual Estimator r as an Estimator of the Finite Population Correlation Coefficient in Probability Proportional to Size with Replacement Sampling

BY JAI P. GUPTA

Punjab Agricultural University, Ludhiana

The usual estimator r of e for finite populations in case of PPSWR sampling has been studied in this paper. The bias, its upper limit, variance and estimate of the variance of this estimator has been obtained. The efficiency of the estimators r_1 proposed earlier by the Author and r alongwith what we do in practice has been discussed.

The findings of the empirical study are that none of the two estimators r_1 and r is consistently superior to the other. The variance of the estimator r as $(1-e^2)^2/(n-1)$ is used in practice irrespective of the sampling scheme used in drawing the sample which Gupta *et. al.* (1978) have shown is appropriate for bivariate normal populations. It is observed in the fifteenth populations considered that this variance is more in some cases and less in the remaining cases in comparison to the actual finite population variance $V(r)$ for PPSWR sampling.

4. A Sampling Procedure with Inclusion Probability Proportional to Size

BY A.K. SRIVASTAVA AND D.K. SHUKLA

I.A.S.R.I., New Delhi

The paper presents a sampling scheme with unequal probability without replacement in which inclusion probability of units are proportional to sizes (I.P.P.S.). The sampling scheme is an improvement on Steven's I.P.P.S. procedure. In Steven's procedure, grouping of population units is done into non-overlapping groups such that each unit of a group (say i -th) has got same sizes X_i 's. Let N_i be the number of units in the i -th group. The group sizes N_i are required to be greater than or equal sample size n . This requirement is too restrictive and the proposed sampling scheme has got less restrictive condition than the Steven's one. The proposed sampling scheme also satisfies the sufficient condition for non-negativity of the estimator of variance.

5. A New Method of Drawing a Sample Containing Two Distinct Units with Unequal Probabilities

BY M.N. DESHPANDE

Institute of Science, Aurangabad

In this paper, a new method for drawing a sample containing two distinct units with unequal probabilities is presented. The

method is very simple. Here computation of inclusion probabilities π_{ij} are very easy. Some interesting properties are presented.

6. A Comparison of Certain Two-phase Ratio Estimators

BY M.C. AGRAWAL

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Subject to the same total expected cost, the usual two-phase ratio estimator using a dependent second-phase sample has been examined, from the standpoint of bias as well as mean square error, *vis-a-vis* certain two-phase ratio estimators based on an independent second-phase sample. It has been shown that the former, through an appropriate allocation of available resources, could perform better than any one of the latter under simple conditions derived in the paper. In the case of an infinite population, the former estimator and two of the latter are found to be equally precise.

7. Sequential Approach to Sample Surveys

BY FAURAN SINGH CHAUDHARY

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The sequential sampling technique has been steadily gaining ground as a dependable and feasible scientific tool in the field of Sampling Theory. As a matter of fact it has won acceptance the hard way after it established its credentials of possessing better resilience and higher reliability potential in comparison with the fixed size technique. The initial neglect meted out to it by the scientific community has been replaced by an every increasing interest and notice on their part. Having come out of the period of neglect, sequential sampling has struck and is well on its way to universal acceptability and recognition. The present study attempt to come to grips with some of the most vital problems related to sequential sampling, *viz.*, the determination of the population size when finite but unknown; decision about sample size; estimation of the population mean; sequential generalized estimators and the optimal sequential estimation. It need not be stressed that satisfactory solutions to these problems evolved in the present study have strengthened the theoretical base sequential sampling and added to its credibility.

8. On Generalized Sequential Estimators

BY FAURAN SINGH CHAUDHARY, *HAU, Hissar*

AND JAI BHAGWAN SINGH

G.B. Pant Univ. of Agri. & Tech., Pantnagar

Recently some authors have given an approach to defining both parameter and estimator in terms of the basic concept of

probability measure. In the present paper, the idea has been extended to measure the variance of such estimators. The risk function of a sampling structure has been defined and a stopping rule to terminate sampling has been derived.

9. A Sequential Estimation of Population Size

BY FAURAN SINGH CHAUDHARY

Hissar Agri. University, Hissar

AND

RANDHIR SINGH KHATRI

I.A.S.R.I., New Delhi

For estimating the plaice population, the capture—recapture method is quite popular with the biologists. Some authors have worked out methods suggesting new approaches. In the present paper an attempt has been made to study sequential sampling without replacement method with the help of sequential sampling with replacement method. Curves showing relationship between (i) proportion and difference; (ii) difference and the relative precision, and (iii) proportion and the relative precision are shown for different values of population sizes and number of individuals recaptured. Necessary illustrations have been given and utility of the method has been proved.

10. Unbiased Estimators Using Ancillary Information

BY LAL CHAND

J.N.K.V.V., Jabalpur

Unbiased estimators of the population mean have been proposed through using ancillary information in selection. Lahiri scheme of selection procedure has been suggested to make the ratio and ratio-type estimators unbiased. A generalized selection procedure and the corresponding general estimator using λ auxiliary variables has been suggested. The variance of the estimator using two auxiliary variates have been found by the author to $O(n_0^{-2})$ but are not given in the paper due to their complicated and long expressions. A numerical illustration is given comparing the relative efficiency of the proposed estimators with the simple mean and the Hartley-Ross ratio-type estimators which are also unbiased estimators. These indicate the proposed estimators to be the most efficient,

11. On a Simulation Approach to Study Bias in Ratio Estimates

BY B. N. NARASIMHAN & S. S. PILLAI

I.A.S.R.I., New Delhi

Simulation is a process that employs a computerized model of certain significant features of some physical or logical systems. Providing an experimental model for the accumulation of data on the the target system is the main objective of this process. The simulation technique is due to John Von Neumann.

In this study, using the technique of Simulation we generated populations of different sizes. These populations were following either Bivariate Normal distribution or Bivariate Exponential distributions. From each of the generated population, all the possible samples of specific sizes were drawn and the "true bias" was calculated over these samples. Also, the bias in the ratio estimator of the population total of the variable Y by Sukhatme's first order and second order approximations were calculated and a comparison was made between these biases. The comparisons showed that the first approximation due to Sukhatme is better than the second approximation. Hence we conclude that there is no point in going in for the second approximation and that the first approximation will itself serve as a guideline to the extent of bias in the ratio estimate. This fact was also verified with the help of two real world populations, data on which were taken from published records.

12. Use of Ancillary Information in Estimating Enumerator Bias

BY B. K. BHATTACHARYA

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AND K. S. KRISHNAN

I.A.S.R.I., New Delhi

In recent years non-sampling errors have drawn attention of research workers. Out of various non-sampling errors, non-response error has been dealt by various authors. Observational error is another important type of non-sampling errors. Mahalanobis first recognised the enumerator effect in surveys and developed the technique of interpenetrating sub-sampling. Theoretical aspects of observational error has been dealt with by some authors. Interpenetrating sub-sampling alone can estimate observational error.

In the present study the technique of interpenetrating sub-sampling is being used in a modified way so as to allot more than one sub-sample to each enumerator. Stratified sampling procedure is being

adopted at the initial stage and then the technique of interpenetrating sub-sampling has been adopted within each stratum. Allotment of enumerators to different sub-samples in different strata is being done in such a manner that each enumerator is to travel the minimum distance. This has resulted in reduced travel cost. Ancillary information on some auxiliary character, which seem to influence the enumerator, has been used to estimate the enumerator bias. Enumerator bias is assumed to consist of two components, one a constant over all the units a particular enumerator enumerates and the other, a variable component which is expected to be related to the ancillary information.

13. On a Method of Using Ancillary Information in Survey Sampling

BY C. ASOK

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A new technique of using the ancillary information at the designing stage is proposed which is particularly useful in the case of area sampling and cluster sampling and it has been demonstrated that the estimator proposed is always more efficient than the Rao, Hartley and Cochran's estimator. A numerical example is also given for illustration purposes.

14. Sampling Strategies for Population Mean When the Coefficient of Variation of an Auxiliary Character is Known

BY AJIT KUMAR DAS

AND

T.P. TRIPATHI

Indian Statistical Institute, Calcutta

In this paper a wide class of sampling strategies, based on SRSWOR, is presented for the population mean \bar{Y} of a character y , utilizing the knowledge on coefficient of variation of an auxiliary character x . Properties of the proposed class of strategies for large samples are studied and the optimum subclass of the same is found out. A large number of estimators, better than the usual mean estimator \bar{y} under very moderate conditions, are identified.

15. On the Use of Double Sampling in Sample Surveys

BY RANDHIR SINGH

I.A.S.R.I., New Delhi

It is well known that in sampling theory the precision of the estimator may be improved substantially by the use of auxiliary

information available for some character x which is correlated with the character under study y . It may be used for the purpose of selection of the sample, stratification of the population or improving the estimator of the parameters, when such information regarding the auxiliary characters is leading. The usual technique of double sampling is resorted where a large preliminary sample is selected in which the auxiliary character above is measured and a smaller sample is selected for observing the character under study. The smaller sample may be selected in two ways namely: (i) The smaller sample is a random sub-sample from the larger sample; and (ii) the smaller sample is independently selected from the population.

The concept of double sampling was given as far back as 1938 by Neyman (1938) while examining the problem of stratification and has been extensively used in surveys since then. However, it has not been very clearly shown which of the two procedures mentioned above provides more efficient estimator though in practice generally procedure (i) in which the smaller sample is a sub-sample from the large sample is followed. But through the present investigation it has been shown that the procedure (ii) in which the smaller sample is selected independently provides more efficient estimator.

16. Estimation of Milk Production Utilising Partial Milk Recording Data

BY G. CHOKKALINGAM AND K.C. RAUT

I.A.S.R.I., New Delhi-12

The methodology developed by the Indian Agricultural Statistics Research Institute (IASRI) for the estimation of milk production in an area requires the weighment of milk yield for the ultimate unit (*i.e* animal in milk) both in the morning as well as in the evening. The character under study which is the day's production is the aggregate of the yield in the morning and evening and is obtained for each of the ultimate stage unit and estimate of average annual/daily milk production are obtained following the sampling design adopted in the investigation. The present study deals with the existing method, correlation between the milk yield in the morning and evening, functional relationship between the yield at two times and testing the difference between the recordings. On the basis of a modified approach the estimates of production separately for morning and evening have been worked out. A flexible and operationally feasible plan of work which minimizes most of the difficulties encountered in the present plan of work has been proposed.

17. On Choice of Sampling Units and Method of Selection.

BY V.K. DWIVEDI

I.V.R.I., Izatnagar

AND

A.K. SRIVASTAVA

I.A.S R.I., New Delhi

For estimating the production of fruits, generally the sampling design adopted is stratified multi-stage random sampling. In the present study the aspects of choice of sampling units, their method of selection and corresponding method of estimation has been tackled. Generally, villages or a cluster of villages are taken as primary sampling units with orchards as secondary stage units and cluster of trees as ultimate units of selection. The appropriateness of selection of orchard at the second stage selection has been examined alongwith suitability of probability proportional to size method of selection for primary stage unit. On the basis of data collected in an apple survey conducted in Nainital in (1973-74), it was observed that dropping orchards at a stage of selection has brought substantial improvement in the efficiency of estimator of production. Selection of primary stage units with probability proportional to the number of bearing age apple orchards has also contributed towards the efficiency.

18. Biased T_2 - Class of Estimators Better than $H-T$ Estimator.

BY PULAKESH MAITI AND T.P. TRIPATHI

Indian Statistical Institute, Calcutta

The T_2 -class of linear estimators (Horvitz-Thompson, 1952; Koop 1963) for Y , the population total of a character y , in case of general sampling designs is revisited and a sub-class of biased estimators from T_2 better than $H-T$ estimator \hat{Y}_{H-T} is identified. It is found that in case of a class of sampling designs, we may always generate estimators better (in the sense of having smaller mean square error) than \hat{Y}_{H-T} . Another biased sub-class of estimators $T_2^* = (\alpha/v) \sum Y_i/p_i$, $p_i = x_i/X$, $i=1,2,\dots,N$, α being a suitable chosen constant and being expected effective sample size, from T_2 is also studied and members from T_2^* better than \hat{Y}_{H-T} are identified in case of some designs and populations.

19. Asymptotic Distribution of Some Multivariate Test Statistics

BY SADHANA TIWARI AND O. P. BAGAI

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Box (1949) and Anderson (1958) have given the asymptotic distribution of a general multivariate test statistic whose h^{th} order

moment is expressible as certain function of gamma functions. They applied a very complicated procedure through characteristic function, expansion of gamma function due to Barnes and then the Laplace inversion theorem. We have, on the other hand, applied two very simple alternative procedures. In the first procedure, we have avoided the use of characteristic function and have resorted only to the Barnes expansion formula and then the Mellin inversion theorem. The Second procedure is still simpler in which we have only applied Stirling's approximation formula to gamma functions and then again the Mellin inversion theorem. All these results agree with each other. Further, Box and Anderson have introduced a dummy multiplier ρ and then have substituted its value suitable to different test statistics. We have avoided this as well. Finally, we have demonstrated the use of the finally obtained distribution function to certain known test statistics under certain hypotheses.

20. A Note on Conversion of A Game into A LP Problem

BY M.T. BHARAMBE

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In this note, a method of breaking a tie for the entering vector (in simplex method) in solving a game problem through linear programming technique has been suggested.

21. Stability of Rating-Curves Over Time and Space

BY PUNAM BHASIN

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For hydrological investigations accurate and systematic stage-discharge records are used. It is relatively simpler to obtain records of water level, but there are numerous difficulties in measuring discharges. Rating-curves are therefore, often used for estimating discharges. Reliability of the estimates of discharge by using rating-curves is affected by the stability of rating curves. Generally, it is found that rating-curves differ from site to site and over time in the same site. In this paper nature of change of rating-curves from site to site as also over time in the same site has been investigated. Data from a few sites on the Mahanadi and Ganga basins are considered for study. Monthly rating-curves are fitted for two sites of each of the above two basins to see the stability over time and space. The study has been done on the daily stage-discharge data for the three years.

The model used for the rating-curves is :

$$Y = a(X - X_0)^b$$

Where Y = Discharge of the river at a particular site

X = Stage of the river at a site

X_0 , a & b are constants.

Computer service has been utilised for obtaining the least squares fit to the model.

It is found that the rating-curves are not the same for the monsoon and non-monsoon seasons. Even during a season the curves are different in some years. Thus estimation of discharge by using rating-curves needs frequent checks and should not be done mechanically.

22. A π ps Sampling Scheme

BY A. DEY AND KAMLESH SINGH

I.A.S.R.I., New Delhi

In unequal probability sampling, it is known that considerable reduction in the variance of the Horvitz-Thompson estimator (estimating the population total) can be achieved if the sampling scheme ensures that the inclusion probability of any unit is proportional to its size. Such sampling schemes are called π ps sampling schemes. In the literature, there are three well-known π ps schemes for any general n , viz. : (i) due to Midzuno-Sen (1952) (which is generally non- π ps but can be made π ps by defining a set of revised probabilities of selection), (ii) due to Sampford (1967) and, (iii) the pps systematic sampling of Madow (1949). The method (i) becomes too restrictive in practice and is hardly applicable in real situations while method (iii) suffers from the drawback that there is no unbiased estimator of the variance. Method (ii) is computationally too cumbersome.

In this paper, a new π ps sampling scheme is suggested which combines methods (i) and (iii) and is free from any drawback. The suggested procedure is seen to perform well when tested empirically on a number of natural populations.

23. Block Designs for Mixture Experiments

BY M.S. RAMACHANDRA MURTHY AND J. S. MURTHY

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Control of error in experimentation has been an important problem and division of points into blocks has been a common practice to achieve this objective. Since the number of design points increases with the number of components in a mixture, homogeneity

of experimental conditions may not be attained throughout the course of experimentation. Therefore, greater accuracy can be achieved by conducting such experiments in blocks.

In this paper, a method of non-orthogonal blocking of symmetric simplex designs of Murthy and Das (1968) and another method of non-orthogonal blocking of designs for mixture experiments using orthogonal arrays is given. These methods provide blocks satisfying the modified blocking conditions of Nigam (1976).

24. Evaluation of $1+x^a$ As Power of x in Galois Field

BY R.N. SHIL AND M.L. AGGARWAL

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To express $1+x^a$ as a power of x in general, where x is the primitive element in a Galois field is an unsolved problem. This is needed while constructing Orthogonal Latin Squares and also for drawing Systematic Sampling. Though by following the existing method of expressing exhaustively each of the elements as a power of x , the above problem can be solved, it is very much time consuming particularly when the number of elements in Galois field is very large.

As such an attempt has been made to provide suitable methods of solving the problem. For a solution, it is necessary to obtain an expression containing three terms equal to zero. Sometimes the minimum functions provide such expressions but one expression is not adequate.

It can be shown that for GF (p^n)

$$1+x^{2n/3}=x^{n/3}.$$

where n is defined by $x^n=-1$ and is divisible by 3. For example :

when $p=2$ $m=4$, we have $n=15$ and

$$1+x^{2 \times 15/3}=x^{15/3} \text{ i.e. } 1+x^{10}=x^5.$$

Several other methods have also been discussed.

25. Construction of Resolution IV Designs for Certain

Asymmetrical Factorials

BY A. K. BANERJEE

I.A.S.R.I., New Delhi

A resolution IV design is one which permits the estimation of all main-effects when 3-factor and higher order interactions are assumed to be zero. In this paper, a procedure for obtaining resolution IV designs for asymmetrical factorials of the type $t \times s^n$ in $t \times s^p$ ($p < n$) runs is described, where t and s are both primes or prime powers. A number of useful designs are obtained through this method.

26. Symmetrical n -Ary Unequal-Block Arrangements With Two Unequal Block Sizes

BY V. S. SOUNDARA PANDIAN

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In agronomic and other tests involving a large number of treatments, among which interactions do not exist but repetitions of treatments within blocks are allowed, the need for the reduction of the size of the block for efficient control of soil heterogeneity is insistent. Shafiq and Federer (1979) have shown that it is impossible to find a balanced n -ary design that is as efficient as a binary BIB design. Further these BN designs become useless when the natural blocks comprise different number of plots. John (1964) and then Kulshreshtha *et. al.* (1972) have given methods of construction of BIB and BT designs with unequal block sizes and unequal replications. Nigam *et. al.* (1977) have generalized these methods to n -ary designs with larger number of blocks. But to meet these contingency with equal replication, following the line of Symmetrical Unequal Block (SUB) arrangements given by Kishen (1940-41) and Raghavarao (1962) for binary arrangements, Symmetrical n -Ary Unequal Block (SNUB) arrangements of two block associate classes, have been introduced.

The concept of *SNUB* arrangements—an extension to binary *SUB* arrangements—consisting of the incidence matrix N with n elements $0, 1, \dots, (n-1)$ and following the two block association class property, is a completely balanced arrangement with constant Λ and R , but with different block sizes. Various methods of construction of *SNUB* arrangements with two unequal block sizes have been studied in detail in this paper. Many new series of *SNUB* arrangements are obtained first by using two associate class *PBIB* designs like (i) Group-Divisible, (ii) Triangular and (iii) Latin Square type designs; secondly from (iv) Affine-Resolvable *BIB* designs and (v) *GD-PBIB* designs with *BIB* designs and finally from method of finite differences with two types of initial blocks. Ternary and n -ary block designs have also been used in the construction of *SNUB* arrangements.

27. Sampling Methods and Procedures for the Determination of Potential Crop Yield Index (PYI) for Estimation of Grain Production in Rice

BY K. M. PALANISWAMY,

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Grain production in rice crop was assumed to follow the model $y = g.p.w.$ where y is the estimated total grain production, g is the

number of grains/plant, p is the number of plants and w is the grain weight. As dispersion of g in plant population is wide, the mean of srs will have more variance. The possibility of ratio method was investigated using the grainnumber-related auxiliary variable namely grain weight (X). Data collected from a 3×2 experiment involving 3 N levels (0, 60 and 120 kg/ha) and 2 varieties (*IR 22* and *IR 662*) were considered. Nature of data included : height of tiller, panicle length, grain number, grain weight and unfilled grain number/panicle. $PYI(Y)$ was estimated using the ratio y_i/x_i and X (grain weight/plant). The sampling units were obtained in six different schemes based on the position of the tillers in a plant. Purposive selection of tillers was found better rather than random selection of sampling units. Estimated Y and actual Y were compared and error estimated. The ratio method gave error ranging from -2.23% to $+0.37\%$. The variables y and x satisfied all the conditions that make the ratio estimator best. The possibility of adoption of a common ratio was explored. The mean ratios differed among N levels, varieties and schemes. VN interaction was significant. The mean ratios at 0, 60 and 120 N kg/ha were 40.416, 39.710 and 39.504 respectively. A common ratio could not be recommended. N decreased the ratio as the influence of N on grain weight was more than its influence on grain number. Varieties caused variation to an extent of 96.2% followed by N which explained only 2.2% variation in the ratios. The ratio method was found suitable to estimate PYI of a crop and $S 1$ and $S 2$ was preferable in the selection of sampling units for estimation of the sample ratio. The bias was found negligible. A sample sizes of 69, 82 and 91 were required for estimation of R as well as \bar{T} within 3%, 2% and 1% error respectively.

28. Fitting Orthogonal Polynomial in Presence of Con-committant Variable

By S.P. SINGH and M. PRATAP

J.V. College, Baraut

The technique of fitting orthogonal polynomials for regression analysis is well-known when the values of the independent variable are given at equi-spaced intervals. If in addition to this independent variable, a con-committant variable is present and affects the response, the analysis has to be modified accordingly. In the present investigation it has been shown as to how the data obtained from various experimental designs in such situations is analysed. The regression S. S. and residual S. S. are computed to prepare the analysis of variance table. Variances and convariances of the various estimates

can also be obtained. In certain circumstances it is needed to split up the adjusted treatment sum of squares into various components such as sum of squares due to linear effect, quadratic effect etc., when presence of a concomitant variable is assumed. This can be done by using the above technique of fitting orthogonal polynomials in the presence of concomitant variable. Thus it provides a very useful application of the above technique.

**30. Certain Recurrence Relations for Power Components of
A Sometimes Pool Test Procedure in A Mixed Model**

BY M. A. ALI

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A testing procedure based on two preliminary tests of significance in a mixed model situation arising from a split-plot in time experiment has been considered. Power of the test derived in series expressions is much involved with the viewpoint of numerical evaluation (Ali, 1978). In the present investigation, derivations are given of the recurrence relations for the power components of the test which may be used for the empirical study of the power.

**Selection of Variables and Multivariate Analysis of
Multi-classified Non-Orthogonal Data**

BY S. C. AGARWAL and S. N. KAUSHIK

I.V.R.I., Izatnagar

The methods for selecting the important discriminating variables and analysing the multi-classified multivariate non-orthogonal data as a factorial experiment have been described in the present paper which were hitherto lacking in livestock researches by now. The methodology so described has also been used to analyse the data on Haryana taurus crosses of cattle.

**31. Refinements in the Estimation of Soil and Fertiliser
Nutrient Efficiencies from Field Experiments:
Statistical Considerations**

BY G.R. MARUTHI SANKAR,* M. VELAYUTHAM,*

K.C.K. REDDY* AND K.D. SINGH**

Estimation of soil and fertiliser nutrient efficiencies are very important in soil fertility investigations and fertiliser use recommendations. In the absence of isotopic procedure, the estimation of

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fertiliser nutrient efficiency from treated plots is calculated by using a factor for soil contribution which is estimated only from the unfertilised plots. Recent studies have shown that inconsistencies in such estimates tend to occur. Refinements in the estimates of these parameters are attempted based on statistical considerations and soil-plant relationships. The estimates thus made using the data of a wheat experiment at Delhi conducted under the Soil Test Crop Response Project indicate the superiority of the proposed procedure in realistically apportioning the soil and fertiliser nutrient efficiencies and estimating the fertiliser requirements for specific yield targets under varying soil fertility conditions.

32. Combined Analysis of A Group of BIB Design with Recover of Inter-Block Information

BY K.C. BHUYAN AND T.K. GUPTA

B.C.K. Viswa Vidyalaya, Kalyani

If BIB experiments are conducted independently at p locations under same agro-climatic conditions, possibility of homogeneous error is very much likely and the p experiments may be considered as one having parameters pb , v , pr , k , $p\lambda$ with their usual meaning. If the observations of such a group of experiments follow the Eisenhart Model III (blocks random, error random), we have two independent estimates, namely, intra-and inter-block estimates of treatment and places x treatment effects. Zelen (1957) has given an analysis of incomplete block design utilizing intra-block and inter-block analysis and then combined the two independent tests obtained— from intra-and inter-block analysis. In this paper the idea of Zelen has been utilized for combined analysis of a group of BIB design with recovery of inter-block information. The analysis is performed by inserting an effect term, due to places x treatment interactions, in the model and separate estimates of effects and interactions are presented both for intra-and inter-block analysis. Method for estimating and testing combined intra-and inter-block effects are also presented. Formulae are given for variances of different types of contrast concerning effects and interactions.

33. Method of Estimation of Yield from Summarised Results of Experiments

BY BASANT LAL AND P.N. BHARGAVA,

I.A.S.R.I., New Delhi

In agricultural field experiments, the principal objective is to assess the performance of a particular strain or variety under the

influence of a set of treatments like fertilizers, cultural practices etc. over number of years. To study this aspect, complete data on the yield record for different treatment combinations over years are required. It is observed that the maintenance of record at a research station differs from year to year for the same set of experiment. As such, before the entire data could be analysed, it becomes essential to bring the data on a uniform pattern over years. The pattern of available data at research station is either in the summarised form of two-way tables, or the average yield of treatment combination of an experiment. An attempt has been made to estimate the yield of the treatment combination from the summarised results in case of an experiment planned for 2^n series. However, this method has also been extended for the case $q \times 2^n$. The proposed method essentially consists of first writing the sets of treatment combinations in a standard order and thereafter consider the yield for some of the treatment combinations as unknown. The number of unknowns to be considered in each case depends on the total number of factors involved in the experiment. An another assumption made while estimating the yield for each treatment combination through the proposed method that the higher order interactions are considered to be of negligible order and as such, they are equated to zero for estimation purpose, for example in case of 2^4 , the number of unknown is 5 and the four factor interactions as well as all the three factor interactions are considered as zero for the purpose of estimation. The details of this procedure are however illustrated through an example of 4×2^3 . In this experiment, the first factor indicates the number of strains, while the other three factors (may be three nutrients N , P and K) are each at two levels.

34. Correlation Between Relatives for Sex-Linked Character, With Special Reference to Parent Offspring Mating

BY K.C. GEORGE

Kerala Agricultural University, Trichur

The theoretical values of the correlation between relatives was first developed by Fisher (1918). His initial study was mainly confined to random mating. In the recent past the study of correlation between relatives under inbreeding was mainly due to Kempthorne (1955) and Horner (1956). But their work was mainly on autosomal gene case alone. The progress of homozygosis for sex-linked character has been studied by Fisher (1949) and Haldane (1937, 1955). A detailed study of sex-linked character under full-sib mating has been made by Korde (1960). In this paper, an attempt has been made to study sex-linked character under parent offspring mating in the same line of Korde,

By this study the general expressions for the following correlation coefficients were derived.

(1) Correlation coefficient between the male parents in the n^{th} generation and the male offspring of the k^{th} degree in the $(n+k)^{\text{th}}$ generation,

$$\text{is Corr : } (y_n, S_{n+k}) = n\rho_k = 1 - \frac{(1-F_n)}{2^{k-1}}$$

(2) Correlation coefficient between the male parents in the n^{th} generation and female offspring of the k^{th} degree in the $(n+k)^{\text{th}}$ generation.

$$\text{is Corr : } (y_n, D_{n+k}) = n\rho'_k = \sqrt{\frac{1-(1-F_n)}{2^k}}$$

(3) Correlation coefficient between the female parents in the n^{th} generation and male offspring of the k^{th} degree in the $(n+k)^{\text{th}}$ generation.

$$\text{is Corr : } (x_n, S_{n+k}) = n\eta_k = \sqrt{F_n}$$

(4) Correlation coefficient between the female parents in the n^{th} generation and female offspring of the k^{th} degree in the $(n+k)^{\text{th}}$ generation.

$$\text{is Corr : } (X_n, D_{n+k}) = n\eta'_k = \sqrt{\frac{2^k F_n}{2^{k-1} + F_n}}$$

where F_n is the inbreeding coefficient in the n^{th} generation.

It can be seen that $n\rho_k + 1 = \frac{1 + n\rho_k}{2}$ and $n\rho'_k = \sqrt{n\rho_k + 1}$ and also both $n\rho_k$ and $n\rho'_k$ tends to unity as k tends to infinity. Again it can be observed that $n\eta_k$ is independent of k and $n\eta'_k$ tends to $n \vee k$ as k tends to infinity.

35. A Critical Review of Methods of Estimation of Heritability of Threshold Characters

BY D. VERMA AND J.P. JAIN
I.A.S.R.I., New Delhi

Most of the applications of the concept of heritability have been made with respect to characters showing continuous or graded types of variation. The importance of this parameter, however, extends equally to threshold traits. The various techniques for the estimation of heritability for characters showing continuous variation are well known. These methods, however, are not immediately applicable to threshold characters because the underlying continuous distribution cannot be observed. The purpose of my dissertation was to present a critical review of all available methods for estimation of heritability of threshold characters.

The different methods of estimation of heritability for threshold characters reviewed included those suggested by Wright (1934), Lush (1948), Robertson and Lerner (1949), Bogoyo and Becker (1965), Lush (1950) and Falconer (1965).

36. A Stochastic Model for Economic Appraisal of Dairy Calf Mortality

BY B.V.S. SISODIA AND V.K. DWIVEDI

I.V.R.I., Izatnagar (U.P)

With the advancement of animal breeding programmes there are likelihood of more cross-breds at organised farms as well as in rural areas. The cross-breds are more expensive than indigenous ones in rearing. The cross-breds both adults and young stock may be more susceptible to different diseases as compared to non-descript ones. At the same time these cross-bred calves are economically more valuable than indigenous calves. Therefore, the economics of calf mortality are of primary importance to the veterinarian and farmer or a dairyman as they provide various lines of action for them to be more economical. A high calf mortality rate means more loss to a dairyman and the nation as a whole. An estimate of economic loss associated with calf mortality is so far unknown in most of the instances. Only a crude estimate might be available with individual farmer. Martin *et.al.* (1973) have developed a stochastic model to estimate the economic costs of dairy calf mortality but, their model is incomplete in the sense that some factors *viz.*, value of by-product after death of the calf and, introduction of calf insurance are not taken into the account. Moreover, the cost of a calf rearing in a week in which a calf dies is not appropriately incorporated in the model.

An attempt has been made to build up a new stochastic model considering all possible factors responsible for the economics of dairy calf mortality. One important factor not considered in the Martin's model that is calf-insurance has been incorporated in the model. In fact, it is emphasised in the present study that if calf is insured, the farmer or dairyman can avert his loss associated with risk and uncertainty of the life of the calf, and with this result the calf-insurance will stimulate and motivate to them to take more care of their calves.

37. Estimates of Milk Production and Nutrients Intake in Bovines in Relation to Herd Size Around Karnal

BY S.B. AGARWAL

N.D.R.I., Karnal

The present study was conducted around Karnal during 1973-74 with a view to estimate the milk production of bovines and nutrients intake in relation to herd size. Stratified multistage sampling design was adopted for the selection of sample households. The study revealed that 44 per cent of the households were maintaining only one milch animal, 29 per cent two, 14 percent three and the rest 13 per cent were maintaining more than three animals. The ratio of cow to buffalo was 1:2.3 per stall. About 19.5 percent households were maintaining only cattle, 48.0 percent only buffaloes and the rest 32.5 per cent both cows and buffaloes.

On an average 51 per cent of cows and 56 per cent of buffaloes were in milk. Average daily milk yield per cow per day when in milk was 2.38 kg and that of buffalo 3.7 kg. The yield generally increased with category.

It was observed that a milking cow got more DCP than a dry cow for first two categories and was of the same order for last two categories. The intake of TDN and DM was of the same order. In buffaloes the nutrient consumption increased according to category. A comparison of the standards and the actual intake of nutrients showed that a milking animal got just sufficient quantity of DCP and a little higher level of TDN. These figures were much higher than the standards for dry animals. This indicates that there is a scope for increasing the productivity of animals through better feeding and management practices of animals.

38. The Value of Blood Group Information in Predicting Breeding Value of Quantitative Traits in Dairy Cattle and Buffaloes

BY H.P. SINGH, P. NARAIN AND J.P. JAIN

I.A.S.R.I., New Delhi

The importance of blood group information in predicting breeding value of the quantitative traits in dairy animals has been studied in this investigation. From the accuracies of indirect selection obtained from the data on dairy cattle and buffaloes, it can be concluded that blood group information can be used with advantage for making preliminary selection only when the heritability of the trait is less than or equal to 0.1 and percentage genetic variation controlled

by blood group loci is beyond 5 per cent. These conditions were very rarely met in dairy herds at different farms. This leads to the conclusion that blood group information has very little value in predicting breeding values of any of the important quantitative traits in dairy cattle.

39. Effect of Calf Mortality on Some Production Traits of Cows under Village Conditions

BY K.C. RAUT, SHIVTAR SINGH, R.L. RUSTAGI
AND VIMAL CHANDRA

I.A.S.R.I., New Delhi

Generally, weaning is not practiced in rural areas. When a calf dies the regular milk secretion and easy let down of milk is affected. Accordingly, lactation length, lactation yield, yield per day of lactation, and persistency of dams are affected. Hardly any study has been carried out to compare the production traits of cows having calves with those whose calves have died at different stages of lactation. A study has been made to know the extent of difference between the two groups utilising data collected in a rural area of West Bengal. The study has been made both for non-descript and cross-bred cows. It is observed that the difference was highly significant and well-pronounced for non-descript cows both in the case of lactation length and lactation yield. However, in the case of cross-bred animals the difference between the two groups in respect of lactation yield was significant at 10%. It is interesting to note that the calf mortality did not affect the lactation length of cross-bred cows. A detailed study has also been made to differentiate the performance of cows whose calves died at different stages of lactation. Such studies will indicate the extent of loss in milk due to calf mortality. Measures taken to reduce the calf mortality will lead to reduction in loss in production and indirectly provide indicators for judging the efficiency of improvement programmes.

40. Comparative Performance of Cross-bred and Non-descript Cows in a Rural Area.

BY SHIVTAR SINGH, R.L. RUSTAGI AND SANTOSH SAXENA

I.A.S.R.I., New Delhi

Utilising data collected in the survey carried out in Krishan Nagar area of West Bengal, studies have been carried out to compare the performance of cross-bred and non-descript cows with special reference to their lactation length, lactation yield, age at calvings etc.

The average lactation length of a crossbred cow was 352 ± 11.54 days as compared to 304 ± 5.28 days for a non-descript cow. The average lactation yield of cross-bred and non-descript cows was estimated to be 1032 ± 61.70 kg. and 350 ± 13.76 kg. respectively. The order of lactation had no effect on either lactation length or lactation yield for these categories of cows. The average age at first calving of a non-descript cow was 55.7 months and that of a crossbred 47.1 months. There was no correlation between the age at first calving and first lactation yield. Significant correlation (-0.2126) was observed between preceding dry period and lactation yield for non-descript cows but the correlation was not significant (-0.1681) for cross-bred cows. The correlation between the body weight at first calving and first lactation yield was worked out to be 0.3559 and -0.2818 for non-descript and crossbred cows respectively; but these were not significant.

41. Regional Imbalances in Veterinary Facilities and Mortality

Pattern of Livestock in Maharashtra State

BY S.W. JAHAGIRDAR AND B.G. SAPATE

Punjabrao Krishi Vidyapeeth, Akola (Maharashtra).

The object of the study was to review some preliminary results regarding relative veterinary facilities and mortality pattern of live stock in four divisions of Maharashtra, namely, Bombay, Pune, Vidarbha and Marathwada. The data on veterinary facilities pertained to the year 1976-77 while that on animals treated, mortality and number of artificial insemination cases pertained to the years 1974-75 to 1976-77. The secondary data were obtained from different District Statistical Abstracts and Socio-Economic Reviews published by Government of Maharashtra.

The study revealed very low strength of technical staff members per animal health centre in the State. During 1976-77, the ratio of technical staff (*i.e.* doctors and stockmen together) per centre (*i.e.* hospital, dispensary or aid centre) varied from 1.09 to 1.65 staff members per centre. Number of animals being treated per staff member was high in Marathwada division, while in Pune division the number was much less. Number of animals extended per artificial insemination centre was relatively small in Pune and Vidarbha regions but breeding activities were observed to be promising only in Pune region where as Vidarbha division recorded low rate of artificial insemination cases.

Though rate of mortality was very low for foot and mouth disease, number of attacks for this disease was very high, *i.e.* nearly 71 per cent cases among the overall diseases. Among the most fatal diseases, haemorrhagic septiciemia and black quarter covered considerably large proportion *i.e.* 11 and 13 percent cases respectively. Differential mortality were found among the regions for overall diseases and in specific for black quarter. The study revealed the necessity of high attention in Vidarbha and Marathwada regions to reduce mortality percentage. Among the four regions of Maharashtra State, overall better picture emerges in Pune region with regard to veterinary facilities, disease control and artificial insemination.

42. Effect of Management Factors on Milk Production

BY B.C. SAXENA, H.P. SINGH AND ASHOK KUMAR

I.A.S.R.I., New Delhi.

Studies have been carried out to know the effect of various management factors on milk production but these are mainly based on the data collected under farm conditions. In the present study an attempt has been made to study such aspect under rural conditions. Although the latter study will not give the true effect of various management factors on milk production but at the same time it will reveal to a greater extent the effect of management factors on milk production under rural conditions. The present study however utilised the data collected under a large scale sample survey "Impact of milk supply scheme on rural economy" carried out by I.A.S.R.I. in rural areas of Chingleput district in the State of Tamil Nadu during 1976. The data on management and related characteristics such as housing of animals, feeding practices of animals, milking practices, veterinary facilities, improved animal husbandry practices etc. collected for 720 commercial milk producer households was utilized. For studying the effect of management factors the usual scoring technique was deployed for the purpose.

43. Growth of Rice Production in India—Progress and Prospects

BY HAKIM SINGH AND S.D. BOKIL

I.S.A.S. New Delhi.

It is observed that the rice production in India has been going up steadily though at a smaller rate than Wheat/Cereals. In this context it is of interest to examine the progress in different States and particularly examine the trend in the last decade to secure some indication of what increases in its production may be expected in the immediate future,

For this purpose data on area, production and yield of rice for various States for the period of 1954-55 to 1978-79 (25 years) are examined. It is revealed from the results obtained, that though in traditional rice growing States growth rates are low, there is high growth rate of all the three characters; area, production and yield, in Punjab and Haryana (undivided Punjab). Thus even if in some of the rice producing States, the growth rate of area under this crop is negligible, there is still scope to increase area under rice for India as a whole because of high growth rate of area for the States like Punjab and Haryana.

To make the study on impact of 'Green Revolution' the data (on 25 years) are divided into two parts 1954-55 to 1964-65 (P_1) and 1967-68 to 1978-79 (P_2). The years 1965-66 and 1966-67 are excluded because of their abnormality. A similar study is made for all the three characters for both the periods, P_1 and P_2 . Comparison of the growth rates of area shows that they have been distinctly lower in the period P_2 in various States except Punjab and Haryana and in fact even negative in some States, namely, Karnataka, Kerala and Tamil Nadu. It is close to zero in Orissa. In consequence the growth rate of production has also been of a lower order in the period P_2 .

The values of all the three characters have been predicted for the period 1978-79 to 1981-82 on the basis of the data for the period P_2 with the help of the compound function fitted. On the basis of the results rice production is expected to exceed 54 million tonnes by 1981-82 for India as a whole.

44. Trends in Yield Rates of Pulses in India During the Last Decade

BY M.L. SAHNI AND SHANTI SARUP

I.A.S.R.I., New Delhi-12

An attempt has been made to analyse the trends in the productivity of pulses which are one of the cheapest sources of protein in the Indian diet. The study is based on a ten-year data series on yield per hectare of total pulses during the period of 1967-68 to 1976-77. A linear equation of the form $Y=a+bt$ is fitted to the data and trend values are computed for the initial and the end years and the variation in productivity in different States as well as the All-India average is examined on this basis. Pulse crop development in different States is compared on the basis of growth rates during the decade.

The study reveals that there is a significant depression in the productivity of total pulses in the States of Bihar, Haryana and Jammu & Kashmir while the States of Himachal Pradesh, Tamil Nadu and Andhra Pradesh have shown a significant improvement in productivity during this decade. The All-India average yield of total pulses has declined from 517 Kg/ha in 1967-68 to 474 Kg/ha in 1976-77, though this decrease is observed to be statistically not significant. It emerges from this study that majority of the States in the country have either shown very low or negative rates of growth in the yield rates of pulses during the last decade.

45. Factors Affecting the Foodgrains Production in India

BY B.A. CHANSARKAR

Department of Statistics, Nagpur University

The importance of achieving self-sufficiency in agricultural output, especially of foodgrains was recognised as an essential pre-condition for economic development as early as the First Five Year Plan in 1950-51. The paper analyses the major factors affecting the changes in the supply of foodgrains production in India over a period of 26 years. The analysis showed that while public sector actual outlay on Agriculture, Community Development, Irrigation and Power, Fertilisers consumed and Prices have no significant effect in explaining the variation, the weather conditions, irrigated and non-irrigated land and imports together explain nearly 96% of the variation.

46. Composite Model for Forecasting Rice Yield

BY RANJANA AGRAWAL AND R.C. JAIN

I.A.S.R.I., New Delhi

An attempt was made to develop a composite model for forecasting rice yield of Raipur district using weakly weather variables namely maximum temperature, relative humidity, total rainfall, number of rainy days; agricultural inputs, such as fertilizer consumption, per cent area under high yielding varieties and irrigation and fertilizer rice price ratio. Two weighted weather indices were constructed to reduce the number of weather variables for inclusion in composite model. Forecast model based on weather indices and agricultural inputs alongwith time trend were obtained.

Results of studies showed that additional contribution of agricultural inputs over trend was negligible. It suggests that inclusion of trend as a variable in the model takes care of agricultural inputs

and change in technology. Weather variables alongwith trend could explain above 70 per cent of the variation in yield at about two and half months before harvest suggesting that forecast of rice yield is possible by weather variables alone.

**47. Trends in the Yield Rates of Rice and wheat in India
During the Fourth and Fifth Five-Year Plans**

BY S.R. RAI AND SHANTI SARUP

I.A.S.R.I., New Delhi

This paper analyses the trends in the yield rates of rice and wheat in India during the fourth and fifth five-year plans. Analysis of variance technique is utilized to test the significance of plans efforts on the productivity of these crops. The study reveals that the yield rates in the major rice growing States, covering about 70 per cent of all India area under rice, did not show any change in productivity of rice in the 5th plan over the 4th plan. In respect of wheat crop, all States except Bihar, Jammu and Kashmir and West Bengal contributed significantly towards the increase in the productivity of this crop during the fifth plan.

**48. A Statistical Approach to Factors Affecting the Food Nutrients
Consumption**

BY BHUPAL SINGH, S.B. AGARWAL AND R.K. PATEL

N.D.R.I., Karnal

The present study was conducted in the urban area of Muzaffarnagar district of Uttar Pradesh in the winter season (November to February) during 1976-77. With a view to investigate the present pattern of food nutrients consumption and factor affecting it. A stratified multistage sampling design was adopted for the selection of sample households. The present study covered sixty sample households from four urban towns.

The food nutrients included in this analysis are calory, protein, fat, carbohydrate, calcium, phosphorus, iron, vitamin-A, vitamin-B and vitamin-C. The economic and sociological characteristics of households hypothesised to influence consumption of these nutrients are, income, occupation, education, size of family and socio-economic status. The multiple regression technique was adopted to study the effect of income, size of the family and socio-economic status on consumption of food nutrients. Income/expenditure elasticities were worked out for different socio-economic status families. To study the variation in the food nutrients consumption for different socio-economic group of the families, analysis of co-variance technique with multiple auxiliary variables was applied.

49. An Analytical Study into Inter-district Disparities in the Growth of Punjab Agriculture

BY A.J. SINGH, B.S. BHULLAR AND INDER SAIN

Punjab Agricultural University, Ludhiana

A study was undertaken to examine the regional disparities in growth performance in Punjab Agriculture for the pre-green revolution periods. Specifically, the objectives of this study were : (i) To compare the compound growth rates of area, production and yield of selected crops at the district/State level of the post-green revolution period with pre-green revolution period; and (ii) To decompose agricultural production at district/State level to examine the contribution of different factors to agricultural growth.

The study has concluded as follows :

(a) There are sharp inter-district differentials in the growth rates for the selected crops. The growth rates for paddy have increased for all the districts from the pre- to post-green revolution period. The sharpest growth rates in the production of paddy have been recorded for Ludhiana, Sangrur, Jullundur, Faridkot, Ferozepur, Patiala, Ropar and Kapurthala in the second period. In respect of maize, bajra and gram the growth rates have been generally negative. For American cotton, the growth rates of production have been the sharpest for Sangrur, Bhatinda, Faridkot, Ferozepur and Amritsar in order. The growth rates for wheat have been uniformly positive and have generally accelerated. The growth rates for sugarcane production have been positive and significant for Ropar, Jullundur, Hoshiarpur, Sangrur, Patiala and Gurdaspur,

(b) The decomposition of production at district level has revealed that the yield contribution was above the State average for Sangrur and Gurdaspur whereas area contribution was above average for Ludhiana, Ropar, Kapurthala, Ferozepur, Jullundur, Hoshiarpur, Amritsar and Faridkot. Further price structure had an adverse effect on gross value of output in Ludhiana, Kapurthala, Ferozepur, Sangrur, Amritsar and Faridkot, whereas it had a positive effect in Bhatinda, Ropar, Jullundur, Hoshiarpur, Patiala and Gurdaspur districts.

50. Disparities in Agricultural Growth in Vidarbha

BY B.G. SAPATE AND V.D. BORKAR

Punjabrao Krishi Vidyapeeth, Akola, Maharashtra

The objective of the present study was to examine and compare the disparities in growth rates of area, production and productivity

during the periods before and after introduction of new technology in Vidarbha region. The first period was selected from 1953-54 to 1963-64 and second period from 1967-68 to 1977-78 with the view that coverage under hybrid/high yielding varieties was quite meagre during early 1960's and the years 1965-66 and 1966-67 were characterised by severe drought. The exponential function of the type, $Y = \alpha\beta^x$ was fitted to the time series data after reducing irregular fluctuations. The compound growth rate in percent per annum was worked out by the formula, viz., $(\beta - 1) \times 100$.

Results of the study revealed that inter-district disparities in growth rates of area were widened after introduction of new technology in the crops, namely, rice, wheat and cotton. Whereas in case of production and productivity the disparities were reduced in latter period. Rapid growth in productivity was observed in general, after introduction of new technology in the crops, rice, wheat and jowar. These three crops were mainly responsible for major break-through in agricultural production. Further it was concluded that the impact of new technology was not uniform in Vidarbha region, however, it was quite helpful in nearing the objective of equity.

51. Some Biological and Socio-economical Yield Constraints Observed on Crop Wheat in Adoption of New Farm Technology in Operational Research Area Chittorgarh (Rajasthan)

BY H.B. CHOUDHARY
I.A.S.R.I., New Delhi

Results of National Demonstration conducted at various States indicate that there is a large potential for increasing the farm yield. The present study is an attempt to examine the yield gap and to study the factors responsible for it. The study is based on the survey conducted during the year 1979-80 for assessment of Biological and socio-economical yield constraints operating in operational research area Chittorgarh (Rajasthan). Ten per cent of cultivators are randomly selected from each village where the operational research project is in progress. Some of the Biological and socio-economical constraints observed have been presented. The data received have been divided into three groups according to the size of holding in each of the Panchayat Samiti, viz. NIMAHEDA, CHITTORGARH and CHHOTTI-SADRI. Some of the characters like number of fragments, area irrigated, seed treated, different types of fertilizer applied, family status and amount of loan taken by the cultivators have been compared between groups and significance tested. For identification of yield gap the cultivators in each holding size have been divided

into two groups and the average of these groups have been statistically analysed. The socio-economic constraints observed for non-application of recommended doses of inputs have been presented. The different reasons for shortfall in potential yield have been highlighted in this paper.

52. A Critical Appraisal of the Methodological Investigation into High Yielding Varieties Programme in Selected Districts of the Punjab State

BY A.K. CHOUBEY AND A.K. BANERJEE

I.A.S.R.I., New Delhi-12

Data collected under the scheme "Sample Surveys for methodological investigations into high yielding varieties programme" in the districts of Jullundur, Amritsar and Patiala of the Punjab State for wheat crop, 1977-78 have been utilised to study the various input practices influencing the yield. Majority of the cultivators in the three districts had medium (two to four hectares of cultivated area) or large (more than 4 hectares of cultivated area) holdings. WG 357, the high yielding variety of wheat was the most popular variety grown by the cultivators. Although the highest average yield recorded was for WL 711 which was of the order of 380/ha, the highest yield for WG 357 variety worked out to be about 380/ha. The number of experiments on local varieties of wheat was small for any valid conclusion. The yield rates of *HVV* of wheat was independent of size of holding. The percentage number of fields benefitted by the application of chemical fertilizers as well as their rate of application was more or less of the same order over the three districts. The overall dose of chemical fertilizers (NPK) was close to that recommended in the districts. The yield rates generally depicted an increasing trend which increased input of fertilizers. More than 90 per cent of the field are reported to be well drained and fairly levelled. In a majority of the fields, pre-sowing irrigation was carried out. Majority of the cultivators reported that the seed was procured either from own source or through local body. The practice of sowing the fields with pre-treated seeds was not very much prevalent in the districts. The majority of the fields were sown at normal time (mid-November). The average rate of sowing varied marginally around 86 Kg/ha of seed. Pre-sowing irrigation as well as drainage of soil was independent of yield level. The weather in Amritsar and Jullunder was free from causes likely to damage the crop. The regression analysis of yield and chemical fertilizers did not give any significant result. The results of group of experiments

revealed that the treatment effects do not differ significantly from district to district.

53. Trends and Dimensions in Certain Indicators, Essentials and Accelerators of Agricultural Efficiency in Vidarbha

BY B.G. SAPATE AND S.W. JAHAGIRDAR

Punjabrao Krishi Vidyapeeth, Akola (Maharashtra)

The study was taken for the period 1967-68 to 1975-76 and was confined to eight districts of Vidarbha region of Maharashtra State. The factors like productivity, land utilisation, double cropping and land reclamation which contribute to agricultural production in different ways were considered as 'indicators'. The factors on which these 'indicators' depend were termed as 'essentials' and it comprises area under irrigation, fertilizer use and expenditure on soil conservation. The third category was named as 'accelerators' which includes expenditure on production programme and loan advanced by Agricultural Cooperative Credit Societies. The 'accelerators' were assumed to be helpful in increasing efficiency through 'essentials'. Districtwise compound growth rates were worked out for all indicators, essentials and accelerators by fitting exponential function of the form, $Y = \alpha\beta^x$. Disparities in growth rates were examined using Bartlett's χ^2 and F tests.

The study revealed that every district in the region recorded advancement in the agricultural efficiency during the period 1967-68 to 1975-76. More stress was given to increase only the productivity while attention was not diverted towards other contributors of production. Nearly 11 per cent of the culturable area was found to be under-utilised at the end of period. Enhancement in yield rates could be derived through increase in fertilizer use and irrigation. At the same time, lessening soil conservation measures might have restricted the growth. Financial assistance through Agricultural Cooperative Credit Societies extended quite a good means to take up intensive cropping. Production programme measures were slowed down in the region during the period of study. This had shown some parity with growth rates of fertilizer use and of productivity. Inter-district disparities in growth rates were observed to be existing in respect of almost all factors under study. On the basis of growth rates and the ultimate levels of the factors under study, the districts were ranked in order as: Amravati, Wardha, Buldana, Akola, Nagpur, Chandrapur, Yeotmal, Bhandara.

54. Disparities In Growth Rates of Productivity of Some Important Crops at Division Level in Maharashtra State

BY P.R. WAGHMARE

Marathwada Agri. University, Parbhani

The production per unit area is an important factor in deciding the development of production of a crop in the State, but the productivity or production per unit area differs from region to region due to adoption of new technology and due to different agro-climatic conditions.

A study was undertaken to assess the changes in productivity for the period of 1960-61 to 1977-78 for the revenue divisions in Maharashtra State and the State in aggregate. The risk in productivity was also measured in terms of the co-efficient of variations for the divisions (Aurangabad, Bombay, Pune, Nagpur) and the State M.S. in respect of all the crops. The linear and compound growth rates were estimated for the triannual moving average of the productivity and were tested for their significance. The analysis of variance technique was used to compare the mean productivity of the division with State.

The results of twelve crops, *viz.*, Rice, Wheat, Kharif Jowar, Rabi Jowar, Bajra, Gram, Tur, Mung, Cotton, Sugarcane, Groundnut and Sesamum for the four divisions and the State revealed that the Bombay and Pune divisions were progressive as regards the average productivity for most of the crops under study. Higher growth rates than the State were obtained for the crops rice, wheat, rabi jowar, bajra, gram, groundnut and cotton in Bombay and Pune divisions. The growth rates for kharif jowar and sugarcane were the highest in Nagpur, whereas, the growth rates for Tur were the highest in Aurangabad division. The productivity of Aurangabad and Nagpur divisions was below the State average for the crops like rice, wheat, kharif jowar, cotton, sugarcane and sesamum. High values of C.V. were observed for Aurangabad and Nagpur divisions, implying high fluctuations.

55. Factors Affecting the Costs and Returns in Apple Cultivation in Uttar Pradesh

BY JAGMOHAN SINGH

I.A.S.R.I., New Delhi-12

Apple production is considered to be a profitable enterprise. Labour input, cost of raising the orchards upto bearing stage and

production per bearing apple tree are the factors affecting the profitability in apple cultivation. Negligence of any one or a combination of these factors is bound to affect the return adversely. In the present investigations, an attempt has been made to compare the costs and returns of apple growers utilizing the data in the sample survey conducted for obtaining the cost of cultivation of apple and its marketing practices in Uttar Pradesh by Indian Agricultural Statistic Research Institute, New Delhi.

56. A Study on the Variability in Fibre Yield of Two Jute Species

BY B.C. SASMAL AND V. KATYAL

Jute Agricultural Research Institute, Barrackpore

Sanyal and Ghosh (1945) conducted a uniformity trial with D-154 under broadcast sowing at Jute Research Laboratories, Dacca. Sasmal and Katyal (1980) also conducted a uniformity trial with JRO-632 in line sowing without fertilizer application at the North Farm of Jute Agricultural Research Institute, Barrackpore. Here an attempt has been made to compare the variabilities of fibre yield of two jute species— JRO-632 and JRC-212 in line sowing with the application of fertilizer and to study the influence of size and shape of plots and blocks upon co-efficient of variation (c.v.) and also reduce the variability by adopting confounded and triple lattice designs for a few plots of fixed size and shape.

Uniformity trials on two jute species—JRO-632 and JRC-212 with fertilizer application in line sowing were conducted side by side at the North Farm of the Institute in 1976 in 30×16 basic units after leaving the border on all sides (1 basic unit = 1 m long along E-W by 4 row wide along S-N. The distance between row to row was 30 cm). The c.v. of fibre yield ranged between 46.29% to 15.65% in respect of JRO-632 as the plot size was increased from 1 basic units to 240 basic units. Narrower and elongated plots had less c.v. along E-W than along S-N. This was about 10% higher than was reported by Sasmal and Katyal (1980). The c.v. of fibre yield in case of JRC-212 was between 33.1% to 9.1%. Smith's equations fitted were: (i) $Y = 53.65 \times 10^{-0.2031}$ for JRC-632 and (ii) $Y = 32.68 \times 10^{-0.2381}$ for JRC-212 and both the fits were satisfactory. Substantial reduction in c.v. was brought down by arranging treatments in blocks and further, by the use of confounded designs and triple lattice design in both species of Jute,

57. Yield Pattern for Paddy and Wheat with Special Reference to Castes—A Case Study in the Eastern U.P.

BY G.C. MISRA, SUBEDAR SINGH AND O.N. SINGH

Banaras Hindu University, Varanasi

A study involving the average paddy and wheat yields as an indicator of the impact of new agricultural technology was conducted during 1975, taking six villages in the eastern U.P. to evaluate the extent to which the caste and size of cultivated land influence it. Size of holding and average yields of paddy and wheat were not independent of caste. The yields were maximum for the upper and minimum for the scheduled castes. There was a difference of 6.44 and 6.79 q/ha between these two castes with respect to paddy and wheat yields respectively. Higher and encouraging average yields of paddy (22.07 q/ha) and wheat (24.25 q/ha) clearly suggested that the upper castes with bigger holding responded more to the new technology and there was a need to educate and subsidize the lower castes with small holdings to harvest richer dividends.

58. Research and Development in Rainfed Farming of Marathwada Region (Maharashtra)

BY N.Y. PALIMKAR, S.V. RAIKHELKAR, D.P. DIXIT

AND B.R. LANDE

M.A.U., Parbhani

The scheme for establishment of Dryland Agriculture Research Centre at Marathwada Agricultural University, Parbhani commenced from the year 1977-78, with a development project on Dryland Agriculture in 13 villages of Aurnagabad district. The results of research work of the scheme in three years have given recommendations for alternative cropping for weather aberrations, double cropping under assured rainfall conditions, efficiency of different crops and their varieties under rainfed conditions and inter-cropping in sorghum. When these recommendations with other package of practices for dryland farming were transferred on the farmer field, it was observed that as compared to the average yields at research station, there was reduction in the average yields on farmer's fields to the extent of 20 to 64 per cent in kharif sorghum hybrid, 30 to 45 per cent in rabi sorghum and 75 per cent in case of pearl miller crops.

This might be due to the fact that though the inputs for the demonstrations are supplied to the farmers, its management aspects as timely sowing, weeding and plant protection measures are not

taken at right time due to inadequate knowledge and training in Dryland Farming Technology. This can be improved by adopting training and visit programmes or farmers' field at regular intervals by extension workers and giving minimum price guarantee which will be economically profitable to the farmer under present price situation of inputs for all crops.

59. Comparison of Two Methods of Recording Yield in Surveys for Estimation of Milk Production

BY K.B. SINGH AND B.B.P.S. GOEL

I.A.S.R.I., New Delhi

The sampling technique evolved for estimation of milk production by I.A.S.R.I. and adopted by the animal husbandry departments in the various States of the country involves the recording of data on milk yield of selected animals by actual weighment. However, this is a somewhat costly and inconvenient method and suggestions have been made from some quarters that the method of enquiry in place of the method of actual weighment be used for this purpose. A pilot sample survey to study the relative merits of the data collected by actual weighment *vis-a-vis* those collected by enquiry was undertaken in Rohtak (Haryana) and Barabanki districts (Uttar Pradesh) by I.A.S.R.I. during 1979-80. Data on milk yield of a random sample of animals were obtained by enquiry followed by the method of actual weighment and the estimates of average yield obtained from the data collected by the two methods as also results of some related studies are discussed in this paper.

It was found that the milk yield by enquiry and by actual weighment were highly positively correlated in both the districts for cows as well as buffaloes, the correlation co-efficients being 0.82 or more. The differences between the actual yield and yield by enquiry were found to be significant in Barabanki and not significant in Rohtak district for both cows and buffaloes. In Rohtak district the estimates of average milk yield per animal in milk per day obtained on the basis of two types of data were of the same order both for cows and buffaloes but in Barabanki district the method of enquiry under estimated the yield by 16.3 per cent in the case of cows and 10.9 per cent in the case of buffaloes. It is interesting to note that the levels of milk yield of cows and buffaloes in Rohtak district were much higher than the corresponding levels in Barabanki district. The average yield per animal in milk per day in Rohtak being 2.92 kg and 5.07 kg for cows and buffaloes respectively. The corresponding

figures for Barabanki district were 0.86 kg and 2.02 kg. The studies indicate that the method of actual weighment cannot be completely replaced by the method of enquiry but the two can be suitably combined so as to increase the precision of the estimates obtained on the basis of data collected by actual weighment.

**60. Five-Acre Tribal Farm and the Farmer :
Some Preliminary Observations**

BY BHAGAT SINGH

I.A.S.R.I., New Delhi

Economics of a five-acre tribal farm is entirely different from a farm of the same size in any other area due to multiplicity of causes. This article attempts to present some preliminary observations on the economic status of a five-acre tribal farm family covering both income and expenditure, on the basis of in-depth study recently undertaken in a village of Kinwat Tehsil in Nanded District of Maharashtra. Total farm family income amounts to around Rs. 1500.00 per annum from the farm yielding kharif crops and Rs. 750.00 from non-farm work during idle summer and partly idle during winter season. A farm family lives, generally, on Hybrid Jowar, Tur, Urd, pulses, a few spices and condiments and a few edible leaves available in the forest area. Vegetables, dairy products and other protective foods are rarely used. Very little is available to the family for other household durables including clothes and other customary expenditure. They are addicted to Mahua and other liquors and smoking. Tribal farm family is, generally, in deficit at this level of living to an extent of Rs. 500.00 during the year leading to vices and crimes.

61. Tractor Use/and Technological Changes of Sugarcane Farms

BY BHAGAT SINGH

I.A.S.R.I., New Delhi

Tractor on farm in India has been controversial as to its desirability or otherwise more so in the light of scarcity of oils and lubricants. While it is expected to reduce engagement of human labour in crop production, it is worthwhile to examine whether use of tractor affects farmer's attitude towards farming and technological changes on farm. This has been attempted in this paper through the study of composition of cost of cultivation and input use on two sets of farms, viz., tractor farms and bullock farms, depending solely on animal power for farm work. Productivities of factors of production have also been studied,

Results show that tractor farms with their superior power potential applied excessive ploughings and irrigations to their sugarcane crop. Inter-cultural operations were also beyond optimal level. Higher doses of manures and fertilizers on tractor farms stabilized production for the level of Rs. 3,900 gross returns (1970 price level). Even a smaller package of inter-cultures and doses of manures and fertilizers on bullock farms proved to be excessive. Equilibrium of input-use was stabilized at Rs. 3,002 level of gross returns on bullock farms with scope for marginal adjustments of input use. Thus, traditional farm technology of shallow ploughing with animal drawn plough set a limit to the productive potential of the soil leaving little scope of enhancement with the use of added quantities of plant nutrients. Higher seed rate was also not effective. Higher doses of plant protection can, however, be applied for higher profits. Any attempt towards raising yield rates can be by augmenting farm technology.

62. Use of Principal Component Technique for Estimating the Loss in Paddy Crop Due to Pests and Diseases

BY K.G. ANEJA, G.N. BAHUGUNA,

V.K. MAHAJAN AND M.P. JHA

I.A.S.R.I., New Delhi

The technique developed earlier at I.A.S.R.I., for estimating the crop loss due to pests and diseases involved multiple regression of crop yield using partial data on the incidence of pests and diseases as explanatory variable, *i.e.*, for only one out of the five recorded crop growth stages corresponding to their maximum level. This use of partial data was resorted to with a view to avoid the problem of multicollinearity introduced by using such data for all the stages simultaneously. While tackling the problem of multicollinearity, however, this resulted in an under-estimation of crop loss. The new technique uses the data on incidences for all the crop growth stages *i.e.*, with all their principal components as explanatory variables. It, thus, successfully tackles the problem of multicollinearity. The multiple regression equation provides a better fit to the data in terms of R^2 values as per this technique. Further, it provides estimates of crop loss that are not only free from an element of under-estimation but are at the same time more precise. The paper explains the new technique and gives a comparison of the results using this technique and the earlier one on the basis of analysis of 1976 data for a pilot sample survey on pests and diseases in South Arcot district of Tamil Nadu.

63. **On Some Aspects of Planning of Agronomic Experiments**

BY S.N. BAJPAI AND A.K. NIGAM

I.A.S.R.I., New Delhi

The present paper deals with the appropriateness of the designs applied to agronomic experiments. It was found while evaluating statistically wheat crop experiments conducted in U.P. State during 1966—71 that there needs careful examination of factor treatment nature, its level and its combination with other factors and the unit on which these factors treatments are to be applied. Instances were noted where apparently there were no mistake in plannings but due to wrong selection of experimental site whole object of the experiment was lost. Similarly, due to wrong selection of designs, the desired results could't be achieved and in some cases led to wrong interpretation of treatment response.
