ABSTRACTS OF PAPERS

1. Predictive Estimation of Finite Population Mean Using Product Estimator

BY SURENNRA K. SRIVASTAVA

Punjabi University, Patiala

Let $U=\{1,\cdots,N\}$ be a finite population of N units on which a real variable y is defined which take values y_i for the unit i of U ($1\leqslant i\leqslant N$). To estimate the population mean $\bar{Y}=\frac{1}{N}\sum y_i$ on the basis of observed values of y on units in a simple random sample of size n from U, write

$$\bar{Y}= \frac{n}{N}\bar{y}+ \frac{N-n}{N}\bar{Y}_{\bar{s}}$$

where $\bar{y}$ is the sample mean and $\bar{Y}_{\bar{s}}$ denote the mean of $(N-n)$ unobserved units of the population. In the predictive approach Basu (1971) argued that the Statistician should attempt a prediction of the mean $Y_{\bar{s}}$ of the unobserved units on the basis of observed units in the sample. It is observed that the use of mean per unit estimator, regression estimator and ratio estimator as a predictor for $Y_{\bar{s}}$ result in the corresponding customary estimators of $\bar{y}$, whereas if the product estimator is used as a predictor for $\bar{Y}_{\bar{s}}$, the resulting estimator of $\bar{y}$ is different from the customary product estimator. The new estimator so obtained is compared with the corresponding product estimator.

2. Regular Estimators for Subclasses of Linear Estimators

BY S.G. PRABHU—AJGAONKAR

Marathwada University, Aurangabad

The concept of regular estimator is due to Roy and Chakravarti (1960). For its application they confined to the most general class of linear estimators. The present paper considers some Subclasses of linear estimators.

3. A Modified Ratio Estimator Based on the Coefficient of Variation in Double Sampling

BY D. M. KAWATHEKAR AND S. G. PRABHU-AJGAONKAR
Marathwada University, Aurangabad

Utilising the value of coefficient of variation for an auxiliary variable, a modified ratio estimator for Double Sampling is proposed and it is found that the proposed estimator is efficient than the usual ratio estimator in Double sampling and the simple mean estimator when P_{yx} lies between certain range. Also it is found that the optimum variance for a given cost function of the proposed estimator is less than that of the usual ratio estimator in Double Sampling.

4. On Pooling of Estimates from K-Independent Samples

BY. C. L. AGARWAL
Reserve Bank of India, Bombay

In practice, there may be situations where the estimates based on several samples may have to be pooled to get a combined estimator. If K-independent samples are drawn from a population and it is assumed that the variance of these K estimates differ significantly, not due to their sample sizes but some other reasons, then a weighted pooled estimator based on the K-independent estimates is suggested in this paper. An estimator of the variance of the weighted pooled estimator is also suggested. Through an empirical study based on the data collected during the 26th round of NSSO, it is seen that the weighted pooled estimator is much more precise than a simple pooled estimator.

5. On the T_1—Class of Linear Estimators

BY A. M. PEDGAONKAR
Reserve Bank of India, Bombay

When elements of a finite universe are sampled without replacement with varying probability of selection at each draw, Horvits and Thompson have pointed out the existence of three distinct classes of linear estimators. Following the logic of Horvitz and Thompon, Koop formulated the seven classes of linear estimators. Prabhu-Ajgaonkar studied the T_1, Class in detail and introduced the criteria of empty and non-empty classes. The present paper presents a sampling procedure consisting of selecting first m elements

with varying probabilities with replacement the $m+1$th element with varying probability without replacement and the subsequent $n-m-1$ elements with equal probability without replacement. The estimators engendered by the T_1-class of linear estimators are considered. It is demonstrated that for this samplying procedure the T_1-class is non-empty and interestingly enough that there exists the minimum variance linear unbiased estimator.

6. Some Results in Inverse Sampling
BY M. C. AGRAWAL
University of Delhi

In the context of inverse simple random sampling with re-placement the problem of evaluating inverse moments involved in the variance expression for the usual estimator has been discussed. A non-regular estimator has been designed and some comparative results under the general and limiting conditions are presented.

7. Optimum Allocation in Two-Way Stratification
BY RAVENDRA SINGH, *F.R.I.*, *Dehradun*
AND
O.P. KATHURIA, *IASRI, New Delhi*

Bryant, Hartley and Jessen (1960) had considered the problem of estimation in two-way stratification when the number of observa-tions to be selected from each cell i.e. stratum is not sufficient to get unbiased estimate of variance. They have allocated the sample in each cell on the basis of marginal sample sizes by adopting proportional allocation. While allocating the sample to the marginal rows or columns, they have not considered the variability within orws and/or colums. While the variability within cells may not be very large, the same may not be the case for variability within rows and/or columns. Therefore, by considering optimum allocation of sample units among rows and colums, it should be possible to obtain a better estimator than that with proportional allocation. However, it has been found that optimality with respect to one factor of stratification may not always lead to optimality with reference to other factor of stratification. Therefore, there can arise a number of cases other than the case of optimum allocation along both direc-tions. In this paper, a number of alternative methods of allocations have been studied and their theoretical and empirical comparisons made to see under which conditions a particular case of allocation performs better than others.

8. Optimum points of stratifications for estimating area under HYV of cereal crops

By J. PODDAR AND V. S. RUSTOGI
IASRI, New Delhi

The problems of determining the optimum points of stratification in sample surveys for estimating area under HYV of cereal crops has been dealt with in this paper. An attempt has been made to demarcate the boundary points of strata using different methods by making use of the information on the holding size of the cultivators selected for the Area Estimation Enquiry under the project "Sample surveys for methodological investigations into high yielding varieties programme" in Ambala district of Haryana State during Kharif, 1977-78. The various methods of construction of strata examined were : (i) Equal aggregate output method; (ii) Equalisation of cumulative of $\sqrt{f(y)}$; (iii) Ekman's method; (iv) Durbin's method; and (v) Equalisation of cumulative of $\sqrt[3]{f(y)}$; where 'y' is the area under HYV rice in the holding. The results indicated that the optimum method of construction of strata is the method (v) for 4 size strata and sample size of 40 holdings. With this finding an attempt was made to estimate the total area under HYV rice in Ambala district. It has been shown that method (v) of construction of strata using regression method of estimation provides an estimate of total area under HYV rice with minimum variance.

9. On a sampling procedure with inclusion probabilities proportional to sizes based on Steven's scheme

By A. K. SRIVASTAV AND D. K. SHUKLA
IASRI, New Delhi

An unequal probability sampling procedure without replacement is suggested which ensures that the inclusion probabilities are proportional to sizes. This procedure is an improvement over the stevens's (1958) procedure in the sense that the conditions required for the applicability of the proposed scheme are less restrictive than those of Steven's procedure. It has been shown that the Yates-Grondy (1953) variance estimator is non-negative under the proposed scheme. The variance of the Horvitz-Thompson (1952) estimator under the proposed scheme is seen to be smaller than that of the customary estimator in probability proportional to size sampling with replacement,

10.   On An Improved Estimator of Finite Population Total Using Unequal Probability Sampling Scheme
BY PRANESH KUMAR AND S. K. MAHAJAN
IASRI, New Delhi

In sample surveys, the importance of unequal probability sampling schemes for selecting a more representative sample than that of equal probability sampling scheme, is well known. Further, the Horvitz and Thompsons' (1952) estimator and the variance estimator due to Yates and Grundy (1953) are frequently used for estimation with higher precision. In this paper, an unbiased estimator of the population total for unequal probability sampling schemes is suggested. It is shown that the variance of this estimator is smaller than that of the Horvitz and Thompsons estimator. The efficiency of the suggested estimator using the Midzuno and Sen (1952) scheme is studied with the help of three artificial populations considered by Yates and Grundy (1953).

11.   Comparison of Three Estimators Based on Mean Per Unit and Ratio Estimators
BY S. MOHANTY AND L. N. SAHOO
OUAT, Bhubaneswar

Three different estimators, called w-estimators have been generated using arithematic mean, geometric mean and harmonic mean based on mean' per unit and usual ratio estimators. The efficiencies of w-estimators have been compared with the parent estimators, mean per unit and ratio estimators. Further, it is ovserved that among the w-estimators, the estimator based on harmonic mean is better under certain conditions.

12.   Sampling for Longitudinal Surveys
BY RANDHIR SINGH AND S. DURAI RAJU
IASRI, New Delhi

In sample surveys quite often repeated observations have to be obtained from the same sampling unit at specified time-intervals to arrive at an estimator of the population total or mean. Such surveys are also known as *longitudinal* surveys. In the present investigation, following three sampling schemes have been proposed for obtaning the estimator of the population total in the case of repeated observations over time and their relative merits have been examined under suitable cost functions.

(*i*) The same set of sampling units is retained for observations for all time-stages ;

(*ii*) Completely independent samples are observed at each time-stage separately ; and

(*iii*) A smaller sub-sample is retained to be observed on all the time-stages and it is supplemented by additional samples to be observed at each time stage independently.

13. Estimation from Incomplete data from a bivariate population in two-stage sampling design

By RANDHIR SINGH AND R.S KHATRI
IASRI, New Delhi

In most of the large scale sample surveys, generally multi-stage sampling design is used for selecting the sample and data are collected for several characters. Almost all sample surveys face the problem of non-response from some of the units. While sampling a bivariate population, using a two stage design, it may happen that information may be missing for either or both the characters for some of the selected first stage units (f.s.u.) as well as some second stage units (s.s.u.s.) giving rize to three possibilities when a fixed number of units are assumed to be missing at random namely :

(*i*) The observations for one or both characters missing for some of the p.s.u.s. ;

(*ii*) Observations for one or both character missing for some of the s.s u.s. only ;

(*iii*) Observations for one or both characters missing for some of the units at both the sampling stages.

However the first two cases being particular cases of 3rd case suitable estimators have been developed for estimating the population means for the two characters for 3rd case.

14. Multi-phase Sampling in Multivariate Ratio—Product Estimators

By K.K. TYAGI
IASRI, New Delhi

The efficient use of auxiliary information reduces the variance of the estimator of population mean upto a considerable extent,

Olkin (1958) proposed a multivariate ratio-estimator using p auxiliary characters. The bias and variance were obtained under the assumtion that the population means corresponding to various auxiliary characters are known. All the characters including characters under study were observed on a fixed sample of size 'n'. In some situations, it may not be economical to collect information on all the auxiliary characters for the same larger sample due to varying degree of cost of enumerating different characters. Moreover in some situations the population means corresponding to different auxiliary characters may not be available and in such types of situations multi-phase sampling is resorted to. Bigger samples are taken corresponding to the auxiliary characters having cheaper cost of enumeration while smaller samples corresponding to auxiliary characters having higher cost of enumeration. When some of the auxiliary characters are positively correlated and some are negatively correlated with the characters under study, multivariate ratio—product estimators are used. In this paper, two variate ratio—product and multivariate ratio—product estimators have been developed using multi—phase sampling. The biases and variances of these estimators have also been worked out. Optimum weights for combining ratio and prodnct estimator and their estimators have also been calculated.

15. A note on random non-response in cluster sampling

By Sukhminder Singh and Ravindra Singh
Punjab Agricultural University, Ludhiana

In the presence of random non-responses, the estimates in case of cluster sampling and simple random sampling with replacement schemes have been compared for their relative efficiency and robustness. Here, cluster sampling scheme is purposively taken, since in many practical situations, it is very unlikely to get the response from all the units in the selected clusters. Moreover, the scheme is widely used because of its operational convenience and reduction in the cost. The empirical study reveals that assuming the sample size to be same in both the schemes, the cluster sampling estimate is more efficient in the presence of random non-response whenever it is so with its absence and always less non-response robust irrespective of its efficiency in comparison to the equal probability sampling estimate. Interestingly, the latter part of the result is of independent importance and not in accordance with the theoretical results obtained earlier. Thus, the concept of random non-response can not be considered just as a reduction in the sample size as it seems from the

results of earlier studies. Also the rate of change in relative efficiency decreases whereas the rate of change in relative non-response robustness increases with increase in the probabllity of random non-response.

16. Two Modified difference estimators using auxiliary information

By Sukhdev Singh Sidhu and Sukhminder Singh
Punjob Agricultural Univeisity, Ludhiana

Two modified difference estimators are proposed as alternatives to the usual unbiased simple estimator, ratio, product and difference estimators of a population mean using single auxiliary variable with known total. The modified estimators are constructed based on the units which are not selected in the sample for the auxiliary information. The motivation for considering these estimators is from the variance point of view, i.e., the simple estimator based on $(N-n)$ units will be better than the estimator based on n units for estimating population mean of auxiliary variable whenever $n < (N/2)$. Results of the empirical study reveal that the suggested estimators are more efficient than existing estimators in a desirable range of sample size. Moreover the proposed estimators are unbiased, in comparison to ratio and product estimators, and yield exact results which are simple, to apply. Because of these reasons, the estimators will be preferred to the other estimators.

17. Controlled sampling techniques—an aid to hill area surveys

By Bikas Kumar Sinha
Indian Statistical Institute, Calcutta

Conducting surveys in Hill Areas may pose peculiar administrative and allied technical problems. It is indeed possible to identify and overcome some of these problems by applying the technique of controlled sampling. Roughly speaking, this technique enables the sampler to validate (in probabilistic sense) the use of sample mean and variance (as estimates of population mean and variance) while the sampling procedure is quite different from simple random sampling and is designed to take account of organisational and technical field survey problems. The controlled sampling technique has been discussed in the paper with reference to a household survey in the hill areas.

18.   Usual Correlation coefficient estimator *r* under probability proportional to size without replacement sampling
   BY JAI P. GUPTA
   Punjab Agricultural University, Ludhiana

The usal correlation coefficient estimator *r* of the population correlation coefficient ρ for finite populations in case of PPSWOR sampling has been studied in this paper. The bias, upper bound of bias, variance and estimate of the variance of this estimator has been obtained. A comparison of the usual estimator *r* under PPSWOR sampling and what is done in practice has been attempted. For PPSWOR sampling Midzuno scheme, $V(r)$ is less in all the considered populations in comparison to the estimator *r* for a simple random sample drawn from bivariate normal populations.

19.   On the bias of estimators in successive sampling over two occasions
   BY B.V.S SISODIA AND S.P SINGH
   Rajendra Agricultural University, Pusa, Samastipur

Estimation of population parameters (mean and total) in repeated surveys over successive occasions reqires some other population parameters like coefficient of correlation, coefficient of regression etc. to enable the estimator to be minimum variance linear unbiased estimator (MVLUE). However, the true values of these parameters are seldom known. In the absence of true value of these parameters, the estimators cease to hold MVLUE property. The estimators becomes ultimately biased one. In the present article an attempt is made to study the extent of bias theoretically as well as empirically. Using the Jacknife technique the bias is also reduced to the first order of approximation. An empirical study is also made on this technique. Only the case of two occasions is considered.

20.   On resampling for fixed sample size under cluster sampling
   BY P.C. MEHROTRA
   IASRI, New Delhi

In two stage sampling, if clusters of units are selected at the second—stage from the first—stage units, the number of units to be ultimately enumerated is not under control when the number of units in the clusters vary and is not known in advance. This may result in the number of units to be enumerated being much larger than

planned, leading to operational difficulties, particularly when there are budgetary, trained man-power, and other constraints. Thus, in view of the resources and other constraints, it would be desirable to keep the ultimate sample size of units to be enumerated, as far as possible, close to the planned size. One possible approach to this problem would be to discard a sub-sample of selected second-stage units with a suitable procedure which would ensure the required sample size without complicating the design and retaining the unbiased character of the estimator. Alternatively, the excess number of elements may be discarded randomly from the selected second-stage units. This approach seems to be logical since, for a given number of elements, greater precision would be attained by distributing them over a larger number of clusters than by taking a small number of second-stage units and completely enumerating them. In this paper a procedure for discarding the units from the large sized clusters among the selected clusters has been discussed along with the consquent procedure of estimation of the population parameters. Further, it is shown that from the proposed scheme a number of sampling schemes emerge as particularcases.

21. Use of Multi-auxiliary Information in Estimating the Variance and Coefficient of Variation in Finite Population

By D.N. Shah and M.R. Gupta

Sardar Patel University, Vallabh Vidyanagar (Gujarat)

In survey sampling one of the objective is to obtain improved estimate of the population parameter by utilizing the available information in an optimum way. When data on an auxiliary variable, which is correlated with study variable are available, use of auxiliary information might improve the estimator to a desired extent. In this paper the classes of ratio-type, product-type and ratio-cum-product type estimators have been considered to estimate population variance and coefficient of variation using auxiliary information on two variates. The efficiency of these estimators are compared with the conventional estimators and it has been established that the proposed estimators are better than the usual estimators under moderate conditions. The results are extended to the case of using p (>2) auxiliary variates and it is observed that the efficiency of the estimators increase with p.

22. On Variance Estimation in Unequal Probability Without Replacement Sampling

BY V.K. GUPTA AND P. KUMAR

IASRI, New Delhi

The use of auxiliary information in sample selection often results into a considerable gain in precision of estimation of population parameter. In unequal probability without replacement sampling designs the Horvitz—Thompson estimator and the Sen—Yates—Grundy form of variance and variance estimator are being used. But there is no suitable sampling scheme available for a sample size more than two units because the expression for variance and its estimator involve π_{ij}, the joint inclusion probability of a pair of units, which becomes complicated to compute.

An alternate variance estimator has been suggested which is free of π_{ij}. The variance estimator is unbiased under the super population model. The estimator, however, involves g, a parameter in the superpopulation model. As such, the use of this estimator requires the knowledge of this parameter. The performance of this estimator has been studied empirically using Sampford's scheme. It has been observed that with a knowledge of g the performance of this estimator is better than that of Sen—Yetes Gtundy form or other alternate variance estimators available in the literature. The performane is measured in terms of the stability of the estimator. The performance of this estimator has also been studied in respect of some natural populations in which the g-value is assumed. The performance has been studied for different values of g $(g=0,1,1.5,2,3)$. It has been observed that the estimator is quite stable for different values of g. The estimator, however, in this case becomes biased but the magnitude of the relative bias is very small.

23. An Efficient Class of Estimators for Population Variance Using Supplementary Information

BY H P. SINGH AND L.N. UPADHYAYA

Indian School of Mines, Dhanbad

Using supplementary information on an auxlilaryc haracter x, Das and Tripathi (1978) and Srivastava and Jhajj (1980) have considered the problem of estimation of popualtion variance σ_y^2 of the character 〈under investigation. In this paper another class of estimators for

σ_y^2 has been proposed using supplementary information on x, which is found to be more efficient than the usual unbiased estimator s_y^2. Here, the sampling scheme SRSWR has been utilised. For illustration, an empirical study is provided.

24. Applying Jack-Knife to the Ratio and Product Estimators
BY H.P. SINGH AND L.N. UPADHYAYA
Indian School of Mines, Dhanbad

The study of ratio and product estimation in sample survey has been made using supplementary information. Applying Jack-knife technique, one general class of ratio and product estimators is proposed and then two almost unbiased ratio and product estimators are obtained and its properties studied. The proposed class of estimators include the estimators suggested by Quenouille (1956), Murthy (1964) and Shukla (1976). For illustration, an empirical study is provided, when the auxiliary character is positively correlated with the character under investigation.

25. Combination of Regression and PPS Estimators
BY R.N. SINGH AND HAKIM SINGH
Rajendra Agricultural University, Patna.

It is well known that the suitable use of auxiliary information in sampling reduces the variance of the estimator of population mean considerably. The auxiliary information may be used either at the stage of designing or at the stage of estimation, depending upon availability of such informations for increasing the precision of the estimate of the population characteristics under study. If there are more than one auxiliary characters, the problem remains as to how the entire information can be utilized in a better way. Multivariate ratio, product and regression methods of estimation, two-way stratification etc. provide some alternative soluction to the problem. Singh (1965, 1967) suggested a method of using the two auxiliary variates by considering a ratio-cum-product estimation for estimating the population total of the study variable. On the same line, the regression and PPS estimators of the population mean have been combined and the efficiency of the proposed estimator over usual regression and PPS estimators has been worked out.

26. Use of Auxiliary information for imputation
BY RANDHIR SINGH
IASRI, New Delhi

Recently a lot of work has been done to obtain estimation of missing observations through use of imputations and also to obtain the best imputation procedure. Imputation will be successful if a very close value to the true missing value is imputed. Therefore, it is important to find a class of units whose values regarding the character under study are homogeneous and if any unit from this class is found missing then the average of this class can be imputed without loosing much information due to the missing observation. In the present investigation, the population is classified according to an auxiliary variable such that all the units within a class have same value for the auxiliary variable so that the units class are within the class are expected to have smaller variability with respect to the character under study and further the probability of response will also not vary much within the class. Different imputation producres have been examined using the available information from a class to impute any missing value from that class.

27. Use of Auxiliary Information in the Suggested Two-Stage Sampling Drsign
BY ANAND PRAKASH AND ELLA AGARWAL
IASRI, New Delhi

In two stage sampling design, the normal practice is to select the second stage units (*s.s.u.'s*) either equal in number or in proportion to the size of the *s.s.u.'s*. The former case based on equal number of *s.s.u'.s* from each selected primary stage units (*p.s.u.'s*) does not evidently take into account of the size and variability of the *s.s.u.'s* and hence result in less efficient estimators. Alternatively, if the number of *s.s.u.*'s is taken proportional to size of *p.s.u.*'s, the aggregate of selected *s.s u.'s* become a random variable which is not desirable both from practical as well as theoretical convenience. These aspects have already been dealt with separately by first author and had also suggested a new sampling scheme with a few estimators which have been developed following the simple random sampling without replacement method of selection of *p.s.u.*'s and *s.s.u.*'s. In the present paper, the authors have investigated the use of the suitable auxiliary variable for selection of *p.s.u's* and *s.s.u's* in the suggested sampilng scheme and examined the gain in precision of these estimators with those of the estimators based on SRSWOR.

28. A Switch Over Sampling Scheme for the Internal Auditor

BY K.N. RAM MOHAN AND T. SRIVENKATARAMANA
Bangalore University, Bangalore

Many sampling schemes have been proposed for the inspection in an accounting population, like Monetary unit sampling (Dollar-unit sampling) and Key unit sampling. But all these schemes were suitable for external auditor who checks the materials only at one specified point of time. In the following paper we propose a scheme for the internal auditors use. The scheme being very simple to operate provides a best tool for the Internal auditor. The scheme oscillates between sampling and 100% inspection. The estimates obtained from the above scheme will be more precise than the estimates obtained from other such competing schemes.

29. Use of Double sampling in Estimation of milk Production.

BY K.B. SINGH AND B.B.P.S. GOEL
IASRI, New Delhi

The available sampling methodology for estimation of milk production is quite satisfactory for the state level estimates. But for the district level estimates which are an essential input for micro-level planning this methodology needs improvements. This methodology requires the deployment of whole time investigators for collection of data on milk yeild by actual weighment at the time of milking both in the morning and evening which makes it some-what costly. To evercome these two short comings the Indian Agricultural Statistics Research Institute conducted a "Pilot Sample Survey for studying the relative merits of the data obtained by actual weighment and those enquiry for estimation of milk pro-duction" in the districts of Rohtak (Haryana) an d Barabanki (U.P.) during the year 1979-80. The sampling design adopted was a stratified multistage two phase random sampling. In each district the techsils were adopted as strata. The *p.s.u.'s* were a group of 2 villages each. The unit at the 2nd stage of sampling was a house-hold and the ultimate unit of sampling was an animal in milk. The field work was carried out by a team of 4 enumerators in each district. For recording data on milk yield by enquiry a sample of 20 *p.s.u*'s in a district, was observed but the corresponding number observed for weighment was only a sub sample of 12 villages from the main sample.

The milk yield as recorded by enquiry and by actual weigh-ment was found to be highly positively corrleated but the difference

between the two, as revealed by the paired-t test, was significant in Barabanki district and not so in Rohtak district. The precision of the ratio estimate of average milk yield per day per animal in milk obtained by using the milk yield recorded by enquiry as an auxiliary variable was more than the one obtained by the simple average method which is an indication of the possibility of decrease in the cost of the survey. The percentage standard error of the total milk production in the case of cows and buffaloes was 2.0 and 5.4 respectively in Rohtak district whereas it was 10.7 and 8.0 respectively in Barabanki district. It was also found that for estimating the milk production with a standard error of 10 per cent 20 $p.s.u$'s would be sufficient for recording data on milk yield by enquiry whereas the corresponding number to be observed by weighment can be reduced from 12 to 3. This suggests the collection of data by enquiry by the regular field agency in the state animal husbandry department and by weighment by only one whole time enumerator. This will help in obtaining district wise estimates of milk production in addition to obtaining the statwise estimates without appreciable increase in cost. The collection of data on milk yield by enquiry can be entrusted to the staff of the animal husbandry department in addition to their normal work because for this they need not be present at the stable at the time of milking and can collect the data as per convenience.

30.   **A Study on the Effect of Correlation Coefficients and the Proportion of Matching Units on the Efficiencies of Linear Estimators in Successive Sampling.**

BY S.S. SHASTRI
IASRI, New Delhi

The paper deals with the effect of correlation coefficients and the matcded proportions on the efficiencies of linear estimators in the successive sampling. As a case study only three occasions were taken into consideration. One linear estimators of the second occasion and the two linear estimators *viz.* one based on the entire information and the other based on only last year's information along with their repsective variances and the comparison of these with the simple estimators of the respective occasions, irrespective of matched and unmatched units had already been discussed. In the present paper, the percentage gain in efficiencies of the liner estimators over the simple estimators were worked out. It was revealed that they are mainly based on values of correlation coefficients and the matching proportions.

31. Conducting Sample Surveys for Estimation of Livestock Products Using the Field Agency of Animal Husbandry Departments

By R.S. Khatri, B.B.P.S. Goel and K.B. Singh

IASRI, New Delhi

The sampling methodology for estimation of major livestock products *viz.* milk, eggs, wool and meat envisages the employment of whole time field staff for the collection of basic data which makes the sample survey cost prohibitive. The availability of a large number of stock assistants of the animal husbandry department of each of the states, who are well conversant with the conditions and the people in the villages under their jurisdiction, lead to the idea of utilising that agency and making the method of data collection analogus to the one for crop cutting surveys conducted for estimation of crop yield. For investigating the minimum sample size, required for obtaining estimates at district level with a reasonable precision, which can be entrusted to the stock assistants for the collection of data without disturbing their routine, the IASRI conduced a Pilot Survey for the purpose in Hoshangabad district of Madhya Pradesh during the period 1981-82. The sampling design was a stratified multistage random sampling with tehsils as strata, villages as *p.s.u's*, households as *s.s.u's* and animal in milk as the ultimate unit of sampling. The survey was spread over the entire year covering all the three seasons and in each season a sample of 30 villages, allocated to the different strata in proportion to the number of villages in them, was randomly selected afresh. The selected villages were allotted to those stock assistants under whose jurisdiction a particular village had fallen and they were required to work, on an average, 2 days in a month for a few hours in the evening and morning. For the rest of the day they were free to attend to their respective dispensaries and do the normal routine work. The salient results of the study are :

(*i*) The stock assistants who had collected data worked, on an average, for 12 days during the entire year.

(*ii*) The distance of the selected villages from the headquarters of the corresponding stock assistants was, on an average, 6 k.m. but varied from 1 to 14 k.m.

(*iii*) The percentage standard error of the average milk yield per day varied from 5 to 7 in the case of cows and buffaloes whereas it varied from 10 to 12 for the estimates

of the number of animals in milk. The milk production which is a product of the two was estimated with a standard error of 15 percent in the case of cows and 24 percent for buffaloes.

The result demonstrate the feasibility of super-imposing the plan of work of the survey on the normal routine of the field agency of the stale animal husbandry department. But the sample size for the estimation of number of animals is slightly inadequate. However, the sampling methodology, after modifications, ensures the reasonable precision for the estimate of milk production at a reduced cost.

32.   Estimation of Fish Catch from Inland Water resources in a Region of West Bengal

BY O.P. KATHURIA AND H.V.L. BATHLA
IASRI, New Deihi

In inland fisheries, the estimation of extent of various inland resources and catch of fish from these resources is a major problem. Studies conducted in the past have not resulted in a definite methodology which could be recommended for large scale adoption. For estimating the extent of area under ponds and tanks and of catch from them, the Indian Agricultural Statistics Research Institute, in association with Central Inland Fisheries Research Institute conducted a pilot sample survey in 24-Parganas of West Bengal. For estimating the catch of fish several estimators were tried using cluster sampling, simple random sampling, stratified sampling, ratio method of estimation and PPS sampling and their efficiencies were compared.

33.   Determination of Sample Sizes to Estimate Seed Damage by Insect Pests in Pigeonpea

BY G.C. MISRA, A.R. REDDY AND SUBEDAR SINGH
Banaras Hindu University, Varanasi

The sample sizes of number of plants, pods per plant and seeds per plant were determined to estimate seed damage by major insect pests, namely, podfly and lepidopteron pod borer complex in pigeonpea (*Cajanus, cajan* (L.) Millsp.) cultivar MA-97 in a field experiment conducted during 1982-83 kharif season at the Banaras Hindu University. It was found that at 5 per cent error, sample

sizes of plants, pods per plant and seeds per plant were 47.67, 28.90 and 21.69 per cent of total population, respectively, whereas at 25 per cent error these were 17.44, 11.25 and 5.73 per cent of total population respectively. Thus an increase in per cent error showed a decrease in the sample size. An attempt was also made to determine respective sample sizes to estimate total number of pods per plant and seeds per plant.

34. Assessment of Regional Variation in Yield Rates of Oilseeds — A Cropwise Analysis

By Shanti Sarup and R.K. Pandey
IASRI, New Delhi

Major oilseeds crops are groundnut, rapeseed and mustard, sesamum, linseed and castor accounting for about 96 per cent of the total oilseeds production in the country. Its productivity is quite low as compared to other oilseeds producing countries of the world. Even, within the country, there is a large variation in the productivity in different regions. This paper attempts to analyse the variation in yield rates on per hectare basis of major oilseed crops during the period of 1968-69 to 1978-79. The yield rates of castor showed significant increase of 77 per cent, while for other oilseed crops, the increases were of the order of 5 per cent to 23 per cent and statistically not-significant for the country as a whole. In respect of groundnut crop, the pattern of productivity levels in different states compared to all india average did not change except for Gujarat state where the yield rate excelled the national average while in Andhra Pradesh and Uttar Pradesh, the same fell below the national average. The growth rate of productivity of rapeseed and mustard was significant in West Bengal and Jammu & Kashmir only. The productivity of sesamum witnessed a highly significant rising trend in the states of Karnataka and Rajasthan whereas it showed a declining trend in Uttar Pradesh. In respect of linseed crop, though the states of Rajasthan and Maharashtra had significant increases in their productivity level yet the yield level of this crop in Maharashtra continued to be lower as compared to the all-India average. Significant productivity improvement was noticed in Gujarat state in respect of the castor crop. The analysis infers that there had not been perceptible improvement in the productivity level of oilseed crops in most of the states.

35. Relative Efficiency of various Price and Non-price variables in controlling supply (Hectareage) variations—A case study for Wheat and Rice in Allahabad District (UP)

By Ashok Kumar, S.L. Gupta and I.L. Srivastava

K.A. Post Graduate College, Allahabad

The estimation of hectareage response to price and price variablity is a pre-requisite for agricultural price policies. At the same time, a number of non-price variables as well, enter into consideration in the decision-making of farmer in hectareage alloca-tion under a crop at the farm level. The relative efficiency of added input (price and non price) variables in controlling supply (hectareage) variations for major staple food wheat and rice has been attempted, through Nerlovian model based supply response (log linear) equations, run over time-series (1961-62 to 1977-78) data of Allahabad district, with explanatory powes (R^2) of the equation as the respective measure of efficiency of the input variable(s). With current planted area under the crop (Xt) as the measure of supply (dependent variable), the variables relatively with higher efficiencies were, lagged hectareage ($Xt-1$), pre-sowing rainfall (Rt) and lagged yield ($Yt-1$) for wheat ; and sowing period rainfall (Rt) and lagged yield ($Yt-1$) for rice crop, respectively. The results obtained have been discussed in detail in the paper.

36. MFAL's Impact on Agricultural Development : A case study of Ballia District (U.P.)

By S.K. Srivastava. A.K. Srivastava and Ashok Kumar

K.A.P.G. College, Allahabad

An evaluation of the MFAL scheme launched in 1971 in Ballia District, has been attempted in the present paper for marginal farmers. The cross-sectional analysis was carried out on the basis of beneficiaries, non-beneficiaries (control) and unqualified beneficiaries sample in the year (1977-78), while over time comparisons were made for the beneficiary sample at two points of time *i.e.*, 1977-78 over 1970-71 (post and pre MFAL periods), respectively ; classified under the categories as (*a*) bonafide beneficiary and non beneficiary (*b*) unqualified beneficiary and non beneficiary and (*c*) bonafide and unqualified beneficiaries. The various findings led to conclusions that (*i*) cropping intensity, level of investment, employment days and farm income, have invariably gone up over time (*ii*) growing aware-ness of the neo-seed based technology is casual determinant for such

a shift as is recorded over time (*iii*) the Agency did wield a significant influence on the asset formation as well as resources supplies to its beneficiaries (*iv*) the Agency met with unequivocal success in respect of beneficiaries of milch cattle and agricultural imputs (*v*) the impact of MFAL on beneficiaries (both bonafide and unqualified) is well reflected in net income and gross ratio in augmenting the income.

37. Growth in Area, Production and Yield of Til—A Regional Analysis of Uttar Pradesh

By D.R. Chandra

C.S.A. University of Agriculture & Tech., Kanpur

Time series data of area, production and average yield of til crop for the period 1960-61 to 1979-80 in different regions of Uttar Pradesh have been studied.   Western, central, Bundelkhand, Eastern and Hill constitute five agro-economic regions of the state. The log-linear models have been used for different regions. The study reveal that positive growth in area was witnessed in central Bundelkhand and Hill regions during 1960-61 to 1979-80, significant negative growth rates were observed in western Bundelkhand and Eastern regions during 1970-71 to 1979-80.   All the regions except central and Bundelkhand registered negative growth rates in production during 1960-61 to 1979-80. The rate of decline was found more during 1970-71 to 1979-80 than during 1960-61 to 1969-70 in Eastern and Hill regions.   Yield rates declined significantly in Bundelkhand, Eastern and Hill regions during 1970-71 to 1979-80. Central region recorded positive growth (3.81 per cent) during this period. Yield rates showed declining trend during 1970-71 to 1979-80 as compared to 1960-61 to 1969-70 in Bundelkhand, Eastern and Hill regions whereas reverse position was witnessed in Western and Central regions.

38. A Study on Contribution of Area and Yield to Growth in Production of Pulses

By P.C. Mehrotra and V.S. Rustogy

IASRI, New Delhi

Data on area, production and yield of pulses for the period 1949-50 to 1978-79 were analysed at the all India level to study the growth in production of gram, tur, other pulses and the relative contribution of area and yield to this growth.   The principal finding was that while improvement in productivity has contributed

perceptibly to the growth in production of gram, area has been the main factor responsible for growth in production of tur and other pulses. However, the study also shows that the growth of production of pulses has been quite slow, the growth rate of production over the whole period being 1.3 per cent per annum.

39. Study of Factors Affecting Yield of Groundnut in Chittorgarh District (Rajasthan)
BY R.K. PANDEY AND H.B. CHAUDHRY
IASRI, New Delhi

Groundnut is an important oilseed crop in Chittorgarh district constituting about one-sixth of the cultivated area during kharif season. The average yield of the crop is hardly 8 q/ha ; but in the experiments conducted on the cultivators field in this district, the yield is about 27 q/ha. This yield level has been achieved by using the recommended level of inputs. To determine the various kinds of constraints inhibiting the higher yields in the district, a survey of selected cultivators was undertaken in the Operational Research Project area during the year 1982-83. A number of biological and socio-economic constraints has been identified. Log-linear regression equations have been fitted for examining the relationship between the productivity of groundnut and the input factors *viz.* fertilizer application and plant protection measures.

40. Adoption Pattern of Modern Technology vis-a-vis yield rates of rice in Operational Research Project area of Raipur District (M.P.)
BY B.L KAUL, SHANTI SARUP AND R.K. PANDEY
IASRI, New Delhi

An attempt has been made to examine the extent and intensity of adoption of selected improved practices and the reasons for their non/partial adoption among the selected rice growers. The data for the study pertains to kharif, 1978 and has been obtained on the basis of a household survey of 72 cultivators conducted in 4 villages covered under the ORP in Raipur District (M.P.) The cultivation practices in a package where adoption (singly or in combinations) was examined for assessing adoption level of improved technology by the farmers in the area were (*i*) cultivation of gall-midge resistant varieties, (*ii*) application of chemical fertilizers, and (*iii*) application of plant protection chemicals.

The study showed that the index of adoption of one practice package was the highest (47%) followed by two practices package (33%) and three practices package (13%). Seven per cent cultivators in the area did not adopt any of the improved practices. The analysis, however, revealed that as the number of practices in a package increased, the intensity of adoption (area index) decreased significantly. An examination of yield rates at different levels of adoption of technology revealed that the yield rates of the crop increased significantly as the number of practices in a package were increased. Reasons for non/partial adoption of different components of technology have also been discussed in this paper.

41. Uncertainty in Agricultural Yields in Drought Prone area of Vidarbha Region.

BY CHHAYA BARHATE AND B.G. SAPATE

Punjabrao Krishi Vidyapeeth, Akola (MS).

The objective of the present paper was to assess the instability in crop yields over shorter periods of decade length in drought prone tract of Vidarbha Region of Maharashtra State compristng Buldana, Akola and Amravati districts. The period of study was selected from 1950-51 to 1970-80 comprising the different stages of new technology. Four indicators, *viz.,* coefficient of variation adjusted for trend, probability of crop failure, crop loss ratio and rate of growth in relation to mean yield were worked for different periods, seven principal crops and each district separately to study the instability for different aspects.

The study revealed that during the period 1970-71 to 1979-80 the productivity of cereals has been increased as compared to eariier two decades but in case of commercial crops *i.e.* Cotton and Groundnut and two pulses, Tur and Gram, the level of productivity is still lower as compared to the level of decade 1950-51 to 1959-60. Lower level of productivity of Tur during latest decade exhibited lower percentages of instability, probability of failure and crop loss ratio but in case of Cotton and Groundnut, despite lower levelof average yield it recorded higher percentages for instability, crop failure and crop loss ratio. The performance of Gram was observed to be quite mixed type. The growth rates (in relation to mean) in productivity of these four crops were observed to be neglegible. As regards cereals *viz.,* Rice, Wheat and Jowar, it was

observed that average yield of these crops was steadily increasing over decades and during the decade of 1970-71 to 1979-80, the growth rate of average yield (in relation to mean) was also positive and significant. However increased level of productivity during the latest decade gave rise to increased percentages of instability, probability of crop failure and crop loss ratio, in general. The crop loss ratio was observed to be relatively larger for Cotton, Groundnut and Tur as compated to other crops and amongst cereals it was relatively higher in case of Jowar. On the other hand, instances of crop failure were relatively more 'during the decade 1970-71 to 1979-80 in almost all crops except Tur and Gram.

42. Resources Efficiency of High Input Oriented H4 Cotton vis-a-vis Buri 1007 under low input conditions of small Farmers—A case study.

BY NILIMA CHAUBE AND N.A. GADRE
Punjabrao Krishi Vidyapeeth, Akola

The present study was taken on small farmers possessing land below two hectares of Amravati district. The object of the study was to assess resource efficiency of high input oriented H4 cotton vis-a-vis Buri 1007 variety under the condition of low resource input levels utilization. The data pertains to the year 1981-82 and was collected by cost accounting method. The study indicated that the small farmers are not giving the inputs to the extent required, on account of which they are unable to exploit the vigour of hybrid or improved varieties and to derive optimum returns.

43. Pattern of water utilisation in Vidarbha Agriculture

BY V.D. GALGALIKAR, B.G. SAPATE AND S.W. JAHAGIRDAR
Punjabrao Krishi Vidyapeeth, Akola

An attempt has been made to present some salient facts regarding pattern of distribution of irrigation water, spread up of irrigated area under different crops and to asses the growth over space and time in eight districts of Vidarbha region of Maharashtra State for the period 1963-64 to 1977-78.

The study revealed the low irrigation capacity in the six districts of the region. Bhandara and Chandrapur districts posses relatively high irrigation capacity but in these two districts only, the area irrigated more than once are relatively very low. In general, large proportion of water is allocated to wheat except that in

Bhandra and Chandrapur districts, such proportion goes to paddy. Proportion of irrigation water being diverted to jowar and sugarcane is very low in all the districts as compared to that of the state except in Buldana and Yavatmal districts in case of sugarcane. Cotton and chillies get nearly same proportion of water in the region and in the state but in Buldana, Yavatmal and Wardha districts, the proportion is relatively much high in case of cotton. Percentage allocation of water in case of gram is much differing in the region and in the state but in Buldana, Amravati and Nagpur districts, intensity of irrigated gram is at par with the state. Only Buldana district diverts sizeable irrigation to gram. Irrigation being allocated to groundnut is very meagre in the state and is almost neglible in the region.

As regards to portion of irrigation allocated to food crops as a whole, it is relativity very high in the region as compared to that of state and it is increasing in the reason as well as in the state. In case of non-food crops, the allocation of water is decreasing in the region and moreover, the rate of decrease is substantial. The distribution pattern of water was almost rigid in every district of the region.

In the entire region, area under irrigated wheat is increasing with substantial rate of growth. The distrscts with low coverage under paddy also recorded positive growth rates for irrigated paddy. Only two cotton intensive districts recorded significantly positive growth rate of irrigated cotton. Three of the eight districts of the region showed increasing trends of irrigated area under jowar, gram and sugarcane but hardly one district could record positive growth rate of area under chillies.

44. Impact of drought on the living conditions of Agricultural Households in Delhi

By Satyendra Kumar and O.P. Kathuria

IASRI, New Delhi ·

In order to assess the impact of drought on the living conditions of agricultural households in the villages of Delhi, the data collected under the projects, 'A study on the effect of drought on agricultural production during Kharif (1979-80) and its possible impact on the subsequent rabi crops' and the Pilot sample survey 'To study the impact of new technology on crop production its disposal and employment in agriculture' conducted by the I.A.S.R.I., New Delhi was utilized. The study revealed that 61 per cent of the

agricultural house-holds had holding size less than 2 hectares but accounted for only 18 per cent of the total cultivated area.. On the other hand, about 60 per cent of cultivated area was operated by the 19 per cent of the households with holding size of 4 hectares and above. Nearly 30 per cent households were engaged either wholly or partly in operational work, 16 per cent in non-agricultural work and the remaining 54 per cent were not available for work. This was generally the pattern of employment in agricultural and non-agricultural activities both during drought as well as a non-drought or normal year.

The study also revealed that during 1976-77 which was a normal year of agricultural production in Delhi, out of the total production of their main Kharif crops of Bajra, the cultivators had an estimated marketable surplus of 44 per cent, 51 perc ent kept for self consumption, 1 per cent for seeds and remaining 4 per cent for kind payments. But during Kharif (1979-80), 77 per cent of the area under Bajra crops had suffered heavy to complete loss due to drought in Delhi. Thus during 1979-80, a vast majority of the cultivators instead of having any marketable surplus, either had to depend upon their past grain reserves or on Government supplies for their existence.

45.   Agricultural Growth and Crops contribution—A case study of Amravati district of Maharashtra State
   BY B.G. SAPATE AND NILIMA CHAUBE
   Punjabrao Krishi Vidyapeeth, Akola

The object of the study was to assess relative contributions of different crops in agricultural growth of Amravati district. Decomposition model of Minhas and Vaidyanathan (1965) was used to assess the growth through four components of area, cropping pattern, yield and intraction of cropping pattern and yield. The entire time series from 1974-75 to 1980-81 was selected for study with triennium average of 1971-72 to 1973-74 as base.

The study revealed that productivity was the major contributor of growth in Amravati district followed by interaction of cropping pattern and yield. The contributions of extension of gross cropped area and croppingpattern were relatively mnch low as compared to that of yield and interactions. It was further observed that the major crop, *viz.*, cotton which occupies more than 45 per cent of the total cropped area, could not share the increases in gross agricultural output value. The major contributor of growth was jowar crop which

occupies about 25 to 30 per cent area followed by wheat but the ratio of contribution to the proportion of area in cropping pattern was relatively high in case of wheat. Groundnut and tur which occupy nearly same proportion of the total cropped area as compared to nearly their contributions were relatively low than wheat but were relatively better than jowar on few instances.

46. Influence of Distribution, Uncertainty and Discriminated Spells of Rainfall on Crop Productivity in Akola District of Maharashtra State

By S.W. Jahagirdar and S.G. Thote

Punjabrao Krishi Vidyapeeth, Akola.

In rainfed agriculture, the distribution of rainfall rather than its quantum is more important for crop survival and its performance, and would also be possible that crop productivity is affected only in the situation of severe drought or heavy rainfall. The present study was, therefore, undertaken to assess the influence of rainfall distribution during crop stages, instability in rainfall and occurence of wet and dry spells during each stage on yield of different crops. The study was taken in Akola district of Maharashtra State over the period 1955-56 to 1977-78 for seven principal crops using multiple regression technique. For kharif crops, 12 different rainfall variables and their alternate transformation had been included as explanatory variables for productivity while rabi crop yields were regressed on 7 rainfall variables, along with time trend.

The study revealed that instability in rainfall during the period 4th June to 12th August adversely affects the productivity of rice and groundnut while that of the period 13th August to 30th September affects yields of rice and jower. In addition to instability wet spells of rainfall during entire kharif season also reduces the yield of rice but dry spells of rainfall during the period 1st October to 4th November was observed to be favourable for rice yield. Influence of rainfall was not found on tur, wheat and gram yields.

47. Economics of Cropping Pattern

By S.W. Jahagirdar, B.G. Sapate and D.K. Wankhade

Punjabrao Krishi Vidyapeeth, Akola

An attempt has been made to study relative contribution of cropping pattern in agricultural growth in eight (now nine) districts of Vidarbha region of Maharashtra State. The study revealed that

Cotton and Jowar are the predominant crops of this region with the exception of Bhandara district. Because of the larger area under these two crops, their contribution to agricultural income were relatively high but it was observed that the per hectare gross returns of these two crops and especially of Cotton are relatively low as compared to the overall per hectare return. Though Chillies covers meagre area its contribution to agricultural income was quite appreciable and it was observed to be a most remunerative crop. Groundnut for all the times, Tur since 1970-71 and Wheat during 1976-77 were also observed to be more remunerative than the predominant crops.

In Bhandara and Chandrapur district Rice is predominant crop and its contribution to gross income is next to Chillies. Buldana, Akola and Yavatmal districts could not keep pace with technological developments to select appropriate cropping patterns due to which they were responsible for losses in total out put. In other five districts of the region, the cropping pattern could add something to the total gains, put its contribution was small. The study further revealed that Wheat, Gram and groundnut in Buldana and Akola districts Wheat and Jowar in Amravati, and Jowar, Linseed and Gram in Yavatmal district were mainly responsible for losses but Cotton could gain, sizeably through cropping pattern only on Yavatmal district. In Wardha district Cotton, Groundnut and Rice were contributors to gain and changes through cropping pattern. The picture of Nagpur district is closer to that of Wardha except that Chillies contributed for major gain. In Bhandara district Rice and Wheat are the major contributors of gain the cropping pattern of only Chandrapur district was observed to be balanced in the sense that none of the crops were giving major changes and there had been always a gain through cropping pattern.

48. Labour Utilisation and Its Determinents In Jowar and Cotton Crops—A Comparative Study of Local—*vs*—Hybrid.
By N.S. Gandhi Prasad, Chhaya Barhate and
N.A. Gadre
Punjabrao Krishi Vidyapeeth, Akola.

The present study has aimed at (*i*) to compare the pattern of labour utilisation in cultivation of crops of Hybirds vis-a-vis local varie ties and (*ii*) to study relationship of labour utilisation with area under crop, technology and wage rates. This study was based on 92 growers of jowar aad 80 growers of cotton and a majority of them being small and medium farmers. The study indicated that the scope for

the increase in labour utilisation by bringing more area under H.Y.V. or hybrids is quite restricted as there is only a marginal increase in utilisation of man power to the extent of 11 and 23 man days per hectare under hybrid (*i.e.* 16.8% and 23% over local) jowar and cotton respectively. Functional analysis shows that area effect is negative and significant one indicating under utilisation of engaged labour for both the crops. Wage rate has shown the negative effect while technology registered positive and significant effect on labour utilisation in cotton. In consequence of this, whatever the scope of increased utilisation in labour on account of technology may dwindle owing to area and wage rate effects.

49. A Study on Variability and Growth of Consumer Price Index Numbers for Agricultural Labourer—An Inter State Analysis

BY D.V. RATNALIKAR AND N.S. GANDHI PRASAD

Punjabrao Krishi Vidyapeeth, Akola

The standard of living of agricultural labourers varies from state to state, which may be due to wide differences in the prices of essential commodities. The present paper is an attempt to study the behaviour and variability of consumer price index numbers (for both food items and general items) for assessing the stability of prices in the different states. The states have further been classified into different groups on the basis of the extent of stability of the prices over the period under study. The analysis reveals that for fixing the minimum wages for Agricultural Labourers, there is a need to take into consideration the inter-state differences in the growth and stability of consumer price index numbers.

50. Multiple Growth Models of Production of Wheat, Rice and Sugarcane in Fifteen Districts of Eastern U.P.

BY M.N. SINGH, S.K. SRIVASTAVA AND ASHOK KUMAR

K.A. Post Graduate College, Allahabad

The present paper attempts to examine the nature and extent of relative contribution of various determinant factors in controlling output (Production) variations for wheat, rice and sugarcane crops; in each of the fifteen districts and the whole of eastern Uttar Pradesh. The multiple growth models of production of these crops, *during* the period 1961-62 to 1979-80 have been attempted by taking output of the crop as the dependent variable; with area under the crop (X_1), consumption of nitrogenous/phosphatic/Pottasic fertilisers $(X_2 X_3 X_4)$, amount of rainfall (X_5) and the area under High Yielding varieties

(X_6), as the independent variables, and running multiple linear regressions over the time series (1961-62 to 1979-80) data of the respective indices. The various findings reveal that (*i*) the variables selected in equation controlled maximuma mount of output variations wheat, followed by rice and sugarcane (*ii*) The variable X_1 resulted for crop to positive Coefficients in all the equations, for each of the three crops, to show the direct impact of area on the corresponding production (*iii*) The variable X_2 coefficients were all positive in majority of equations for wheat and rice while for sugarcane positive and negative, evenly (*iv*) The variables X_3 and X_4 also contributed positively, but to lesser extent as compared to X_2 (*v*) The variable X_5 was most effective for crop rice as compared wheat and sugarcane and that (*vi*) all the variables taken together explained 67.67 to 98.19 percent of total output variations for wheat, 36.49 to 81.37 percent for rice and 31.00 to 77.51 percent for sugarcane, respectively as in different districts of eastern Uttar Pradesh.

51. A Class of Resolvable Incomplete Block Designs

BY D.V.S. SASTRY

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Incomplete block designs are extremely useful when number of treatments to be tested in the design is very large and as a consequence the number of replications cannot be large. Practical applications of such designs increase when these designs are resolvable. Many designs exist with two replications and with some restrictions on k and v, designs with 3 or 4 replications are available. In this paper a new class of resolvable incomplete block designs is constructed with 3 and 4 replications based on additive abelian groups.

52. On a Class of Variance Balanced Designs Associated to G D Designs

BY SANJAY KUMAR

University of Lucknow, Lucknow

Balanced incomplete block (BIB) designs introduced by Yates (1936) has been used in a variety of situations. However, in certain cases, balancing requires a large number of replications which are neither desirable from point of view of precision nor are permitted by scarcity of resources. Hence, variance balanced designs have been developed which retain the property of equality of variance of all estimable treatment contrasts and require less number of replications,

The present paper attempts to develop a method of construction of variance balanced designs with the help of GD designs. The variance balanced designs, so developed, are quite useful and optimum in the sense of resource economy. It can also be easily shown that variance balanced design with $v+1$ treatments can be constructed by using associated GD design with v treatments. VB designs through 'm' associate PBIB designs have also been developed. All these designs are in unequal blocks and with unequal concurrences.

53. A Simple Method of Construction of the BIBD (15, 8, 4)

By S.S. Chaudhary

Agra College, Agra

AND

Mahendra Pratap

J.V. College, Baraut (U.P.)

Mehta, Aggarwal and Nigam (1975) has shown the existence of a triangular design with parameters

$$v=b=\frac{n(n-1)}{2}, \ r=k=2(n-2)$$

$$\lambda_1=(n-2) \text{ and } \lambda_2=4 \text{ for } n\geqslant 4$$

on the basis of the triangular design with the parameters

$$v=\frac{n(n-1)}{2}, \ b=n, \ r=2, \ k=(n-1), \ \lambda_1=1, \ \lambda_2=0.$$

Here it has been suggested that a BIBD (15, 8, 4) and its complementary design BIBD (15, 7, 3) can be easily constructed with the help of this theorem. The BIBD (15, 8, 4) can be constructed by taking the 1st associates of the ith treatment ($i=1, 2, ..., 15$) from triangular scheme as the contents of the ith block.

54. Analysis of Partial Diallel Designs

By Ranjit Singh and K.R. Aggarwal

Punjab Agricultural University, Ludhiana

This paper deals with analysis and methods of construction of three-associate class PBIB designs following an association scheme named as Partial Diallel (PD) association scheme. These designs can be used for diallel experiments with P^2 F_1-crosses and P^2 reciprocal F_1-crosses between two sets of inbred lines coming from different genetical or geographical back-grounds alongwith $2P$ parents

of both the sets. The total $2P(P+1)-1$ degrees of freedom (d.f.) can be partitioned into eleven orthogonal sets of $(p-1)$, $(p-1)$, $(p-1)$, $(p-1)$, $(p-1)$, $(p-1)$, 1, 1, 1, $(p-1)^2$ and $(p-1)^2$ d.f. pertaining to parents of the first set, g.c.a. effects of the first set, maternal effects of the first set, parents of the second set, g.c.a. effects of the second set, maternal effects of the second set, parents of first set v/s parents of second set, parents of two sets v/s hybrids, F_1-crosses v/s reciprocal F_1-crosses, a.c. effects and residuals reciprocal effects, respectively.

55.   Extended Right Angular Designs for Diallel Experiments
By Ranjit Singh and K.R. Aggarwal
Punjab Agricultural University, Ludhiana

In this paper an association scheme to be named as 'Extended Right Angular' (ERA) association scheme is given. The PBIB designs, following ERA association scheme, can be used as confounded diallel experiments involving $v=2pq$ crosses between two groups of inbred lines. The total $(v-1)$ degrees of freedom (d.f.) pertaining to the crosses can be partitioned into seven orthogonal sets of $(p-1)$, $(p-1)$, $(q-1)$, $(q-1)$, $(p-1)(q-1)$, $(p-1)(q-1)$ and 1 d.f. said to belong to general combining ability (g.c.a.) effects of the first set of p lines, maternal effects of the first set, g.c.a. effects of the second set of q lines, maternal effects of the second set, specific combining ability (s.c.a.) effects, residual reciprocal effects and F_1-crosses v/s reciprocal F_1-crosses, respectively.

56.   A Simple Method of Construction of some Trend-Free Block Designs
By R.K. Mitra
M.J. College, Jalgaon
AND
G.M. Shah
ISI, Calcutta

The concept of trend-free block designs has been introduced by Bradley and Yeh (1980). But no systematic method of construction of such designs was offered. In this note, a simple method of construction of trend-free block designs, has been presented.

57. Optimal Weighing Designs for Estimating the Total Weight

By S. Huda and Rahul Mukerjee

ISI, Calcutta

The problem considered is that of estimating the total 'weight' of objects using singular and non-singular spring balance and chemical balance weighing designs, with or without restriction on the number of objects that may be included in any single weighing. The presence and absence of bias in the balance are both considered. The study also covers spring balance designs with 'string property'.

58. Repeated Measurement Designs

By A.C. Mukhopadhyay and Rita Saha

ISI, Calcutta

In the present paper Repeated Measurement Designs (RMD's) have been studied under mixed effects model, assuming unit effects to be random and most of the optimality results of RMD's proved under fixed effects model by Hedayat *et. al* (1978), Magda (1980) and Cheng *et. al* (1980) have been re-established in the context of mixed effects model.

59. Some Designs for Parallel Line Assays

By A.D. Das

BCKV (N.B. Campus), Cooch Behar, (West Bengal)

Saha (Sankhya, 1976) has called a class of block designs as C-designs which possesses an interesting property first observed by Calinski (Biometrics, 1971). In this paper a method of constructing a new class of C-designs through the existing ones has been suggested and it has been shown that this method can conveniently be used to obtain a series of incomplete block designs (IBDs) for multiple symmetrical parallel line (MSPL) assays. Using two particular classes of C-designs, two more series of IBDs for MSPL assays have been evolved. It has been further shown herein that the series of IBDs for symmetrical parallel line assays can also be derived as a particular case from all these IBDs for MSPL assays. Besides, the analyses of all these IBDs for bio-assay designs have been provided in general terms. The bio-assay designs proposed in this paper are more advantageous than the existing ones in the sense that the analyses of the present designs are extremely simplified due to the use of C-designs as basic designs.

60. The m-Grouped Cylindrically Rotatable Designs of Types $(1, 0, m-1)$, $(0, 1, m-1)$, $(1, 1, m-2)$ and $(0, 0, m)$

BY S. HUDA

ISI, Calcutta

Cylindrically rotatable designs introduced by Herzberg (1966, 1967) are generalized to m-grouped cylindrically rotatable designs in order to consider the factors partitioned into m sets ($m \geqslant 2$). By restricting the property of rotatability in these sets in different ways these designs are classified into the m-grouped cylindrically rotatable designs of types $(1, 0, m-1)$, $(0, 1, m-1)$, $(1, 1, m-2)$ and $(0, 0, m)$. The conditions which these designs have to satisfy are derived through the moment generating function of the designs.

61. Some Incomplete Block Sequences

BY RAHUL MUKERJEE AND MAUSUMI SEN

ISI, Calcutta

When the number of treatments is large, complete block designs present difficulties as within block homogeneity can not always be ensured. In this paper, the analysis of a certain modified version of serially balanced sequences of type 2 (introduced by Finney and Outhwaite) is presented using incomplete blocks. Their efficiencies with respect to the corresponding balanced incomplete block designs have been studied and certain methods of their construction have been discussed.

62. N-ary Block Designs

BY C.C. GUJARATHI

Sardar Patel University, Vallabh Vidyanagar (Gujarat)

Tocher (1952) introduced balanced n-ary block designs as a generalization of BIB designs. He has given some block structure properties. After the introduction of these desings much research is being put in, which is mainly on construction side. Combinatorial side has been looked into and block structure properties of these designs have been studied in the paper. Mehta, Agrawal and Nigam (1975) have introduced partially balanced ternary design as a generalization of balanced n-ary design. Some block structure properties of partially balanced n-ary designs have been studied in the paper and some methods of construction of these designs given.

63. Computer-Aided Construction of (M, S)—Optimal Incomplete Block Designs

By Nguyen Ky Nam
IASRI, New Delhi

A new exchange algorithm for construction of (M, S)-optimal incomplete block designs (IBD) is developed. The application of this algorithm is made for construction 65 (M, S)-optimal IBD (v, k, b) for $v=4$, 5 and 6 with arbitrary v (varieties), k (block size) and b (number of blocks). The efficiencies of a subset of these IBD's are compared with corresponding nearly balanced incomplete block designs (NBIBD) constructed by John & Mitchell (1977) and by Cheng & Wu (1981). A table tabulating new (M, S)-optimal IBD's is given.

64. Experimental Designs for Correlated Observations

By P.S. Gill and G.K. Shukla
I.I.T., Kanpur

In the conventional analysis of data from comparative experiments the observations are assumed to be uncorrelated. When the experimental units are in space or time the observations are likely to be correlated but random assignment of treatments to units assures independence. However, there are situations when random allocation of treatments may not be convenient. In some situation the structure of correlation may be known exactly and it may be of interest to use this information in designing experiments and analysing data so as to make more precise inference. Recently some work has been done in this direction for designs in one and two dimensions.

In this paper optimum designs for generalised least squares estimators for the comparison of treatment effects is considered. The error models used are (*i*) Besag's first order conditional model, (*ii*) Besag's second order conditional model, and (*iii*) doubly-geometric model. Suitable designs are given for each case. The designs for model (*i*) turn out to be quasi-complete latin squares. These designs are optimum in the wide sense and balanced for treatment comparisons. Balanced designs for models (*ii*) and (*iii*) require impractical number of replications and these designs are not optimal. In some particular cases some designs which are mearly balanced and optimal are presented. Finally efficiency of these designs in comparison to standard latin squares is compared for each case,

65. Construction and Analysis of Incomplete Block Designs for Complete Diallel Crosses Based on BIBD-I

BY S.C. AGARWAL, *IVRI, Izatnagar* AND M.N. DAS,
I-1703, C.R. Park, New Delhi

An attempt has been made to present the construction of incomplete block design for complete diallel crosses (CDC) system-4 of Griffing (1956) based on balanced incomplete block design (BIBD) and its analysis for the crosses effects through the adoption of analysis technique for a BIBD and for the general combining ability (g.c.a.) effects of lines through an appropriate statistical analysis of n-ary block design, the application of which is meagrely available in literature. A worked example is also cited taking hypothetical data for the illustration.

66. A non-iterative Method for Least Squares Estimation of Missing Values in any Response Surface Design

BY S.P. SINGH
J.V. College, Baraut

Several iterative or non-iterative procedures have been suggested to deal with the estimation of missing values. Rubin (1972), however, presented a non-iterative algorithm for least squares estimation of missing values in any analysis of variance design, which is simple and general. Draper (1961) developed a non-iterative method of analysing incomplete data from a response surface design. Some contributions in this direction have been made by S.P. Singh (1980) ane Rakesh Kumari (1982). Here an attempt has been made to present a general method of analysis applicable to all incomplete response surface designs including mixture experiments with or without process variables in piesence or absence of block effects.

67. A Study of "Significance" in Field Experiments

BY P.P. RAO AND M.L. SAHNI
IASRI, New Delhi

Any field experiment is said to be efficient if, even smaller real differences in the treatment means, are detected as significant. A significant result in the F^2 test depends upon a few important factors such as selection of treatments, number of treatments, number of replications, experimental error variance and degrees of freedom for error. Selection of treatments for comparison is generally made on the basis of some prior knowledge and in accordance with the objectives of the experiment. Experimental error varianee is to some extent controlled by uniformity trial and proper choice of a design. The error degrees of freedom also depend upon the choice of the design and number of replications and treatments.

In this paper efforts have been made to study empirically if any relationship exists between the *"significance"* and the block size adopted in an R.B.D., the degrees of freedom for error etc., by considering a large number of experiments on paddy crop in the Southern states of India, conducted during the period 1948 to 1965.

68. On the Relative Importance of Proportion of Components of Various Concentrate Mixtures used in Animal and Poultry Nutrition Experiments
BY S.N. BAJPAI
IASRI, New Delhi

In the present paper relative occurrence of the components of concentrate mixture have been studied singly and in combination based on the experimental investigations reported in compendia volume prepared under the project 'National index of Animal experiments. Further their proportion used as the feed ingredients have also been studied so as to estimate their relative marits with respect to their feed value. The minimum and the maximum proportion in which two ingredients can be used alongwith other feed components are given in matrix form which could be utilized in generating the design points of mixture experiments.

69. Design and Analysis of Grazing Experiments
BY G.V.S. RAMA KRISHNA, T.K. BHATI AND B.K. MATHUR
Central Arid Zone Research Institute, Jodhpur

Designing of grazing experiments for comparing pastures in their productivity based on the performance of the animals grazed on the pastures is very complicated. In view of the big plot size required for grazing experiments one cannot afford replication in such experiments. The design and analysis of such an experiment planned at Central Arid Zone Research Institute, Jodhpur with an objective of testing the feasibility of strip planting of nutritous legumes and shrubs with grasses in discussed in this paper. A two fold hierarchical model is found suitable for each experiments.

70. On the Autocorrelation Functions of the Mean of a Stationary Autoregressive Process of Order One
BY C. ASOK
MACS, Pune

It is often observed that the daily N balanced of an adult individual maintaining body weight on fixed N intake follows a stationary auto regressive process of order one. There have also been instances where it is observed that the autocorrelation of the

first order increases by averaging the daily series over a week. This finding prompted to investigate theoretically whether such a thing can happen in the case of the stationary autoregressive process of order one. A compact expression for the autocorrelation function of the process obtained by averaging the daily series over K days has been derived when the daily series follows a stationary autoregressive process of order one. It has been proved that the autocorrelation gets decreased by averaging the daily series over K days, whatever may be the value of K. Implications of this finding in the field of nutrition are discussed.

71. Paired and Triad Comparisons in Sensory Evaluation
BY S.C. RAI
IASRI, New Delhi

Sensory evalution is assuming increasing importance. Generally the experiments for taste-testing or other sensory evaluation are conducted in paired or triad designs where observations are recorded mostly in ordinal scales. Appropriate statistical methodologies for analysing such experiments are essential.

Two models one for paired comparisons and the other for triad comparisons for analysis of ordered or ranked observations have been developed. For testing the null hypothesis,

$$H_0 : T_i = T_j \text{ for all } i \text{ and } j$$

against

$$H_1 : T_i \neq T_j \text{ for at least one } i \text{ and } j,$$

the following test statistics have been proposed. Paired comparisons :

$$T_1 = \frac{4}{nt} \sum R_j^2 - 9n(t-1)^2$$

Triad comparisons :

$$T_2 = \frac{3}{nt(t-2)} \sum R_j^2 - 3n(t-1)^2 (t-2)$$

where n is the number of repetitions, t is the number of treatments and R_j is the sum of ranks of j-th treatment. The null distribution of T_1 and T_2 have been worked out. The distribution tends to x^2 distribution for large n.

72. A Study on Limitations of Stability Models
BY S.G. THOTE, B.G. SAPATE AND S.W. JAHAGIRDAR
Punjabrao Krishi Vidyapeeth, Akola (M S.)

In the breeding trials, genotype has to undergo various tests to prove its better adaptability under particular tropical conditions. One of the tests, on genotypes, relates to stability of performance

under different environments. Freeman and Perkins (1971) model which is based on linear relationship between environments, and interaction of genotypic effect and environments is widely used for stability analysis. The object of the study was to examine the limitations of this model. The study also examined the feasibility of alternative model based on log-log transformations.

The study revealed that in most of the situations, all the conditions for making stability ranking are hardly satisfied with the result the adaptability of Freeman and Perkin model based on linear relationship between interaction and environment is rarely possible and thus restricts its scope. The analysis based on log transformations, exhibited similar limitations excepting very few cases where situation could improve a little bit.

73. On Problem of Multicollinearity in Crop Production Functions
BY N.S. GANDHI PRASAD AND C.T. BARHATE
Punjabrao Krishi Vidyapeeth, Akola (M.S.)

Least squares estimation method is very commonly used for production functions. However, the limitations and inherent problems associated with this technique have been treated in the literature very recently. Collienarity among independent variables becomes a complex problem. If the condition of collinearity is not subjected for a critical examination, there is possibility of misinterpretation of the results of regression analysis leading to biased conclusions which, in consequence may cause ineffective farm management.

In this study an attempt has been made to detect the presence of multicollinearity involved in production function analysis for AHH-468 and H-4 Cotton with the help of a few measures and to examine the differences in estimates and other summary statistics after the deletion of the variable causing collinearity or near collinearity.

74. Statistical Aspeets of Stability Measures
BY B.G. SAPATE AND S.B. ATALE
Punjabrao Krishi Vidyapeeth, Akola (M.S.)

Eberhartt and Russell (1966) proposed the statility model to study the stability of genotype under different environments, defining two measures based on regression of phenotype effect on environment. Later, Perkins and Jinks (1968), and Freeman and Perkins (1971) extended this model using regression of (genotype x environment) interaction on environment.

In the present paper, limitations of stability measures defined by Eberhartt and Russell (1966) have been discussed and the alternative stability measures proposed based on different crieteria but using the same model. These stability measures are in relative units and lie between 0 to 100 per cent. The simplicity and comprehensiveness in interpretations with newly defined measures vis-a-vis earlier measures have been illustrated with the help of worked out example.

75. Estimation of Heritability for Samples from Non-Normal Situations
BY R.A. SINGHAL
Indian Veterinary Research Institute, Izatnagar

Mathematical expressions to investigate the effects of moderate departure from normality assumption on the point estimate and on the probability of getting a negative estimate of genetic heritability in a balanced situation, have been derived. The numerical results show that the point estimate is remarkably sensitive whereas the urobability of a negative estimate is insensitive to this violation.

76. Use of Exclidean Cluster Analysts in Plant Breeding
BY S.P. DOSHI,
IASRI, New Delhi
AND
R.H. PATEL
G.A.U., Navsari

Usefulness of the method of Euclidean-Cluster-Analysis in plant breeding and genetics for the study of genetic-divergence and classification of geno-types is explained in a non-mathematical language. 83 varieties of Sorghum of diverse origin are classified into 10 clusters by ths method.

77. Maximum Likelihood Estimation of Erechet Distribution Parameters from Censored Samples
BY N.P. SINGH
HAU, Hissar

The estimates of the parameters of Frechet distribution were worked out by the method of maximum likelihood when the highest 'r' sample observations having been censored. The asymptotic variance and covariances of the maximum likelihood estimates for different values of 'r' were obtained and comparative studies were made.

78. A Note on "Freeman and Perkins" Stability Measure

By B.G. Sapate and S.G. Thote

Punjabrao, Krishi Vidyapeeth, Akola

Freeman and Perkins (1971) proposed stability measure for assessing relative stabilities of varieties with respect to genotype performance. Their stability model envisages regression of genotype-environmental interaction on environmental effect measured independently to that of interaction. Normally, regressions of phenotypic effect instead of interaction, are observed to be used in such analysis which is likely to affect the estimates. The present paper examines the estimates of stability measure in either case and shows that regression coefficients so estimated need to be adjusted by substracting quantity equal to combined regression coefficient. Otherwise stability rankings arrived at are with respect to phenotype performance and not the genotype performance. The loss of information is illustrated with the help of worked example.

79. Character Association in Spanish Bunch of Groundnut Genotype

By Chhaya Barhate and S.G. Thote

Punjabrao Krishi Vidyapeeth, Akola

There are empirical evidences that immatured pods in groundnut adversely affects the yield. Most of the studies on path analysis dealt with yield as a dependent character but studies on immatured pods as a dependent character are very few. The present study was, therefore, aimed at examining the direct and indirect effects of different characters on proportion of immatured pods to total number of pods for spanish bunch of groundnut genotypes. The data for the study was adapted from breeding trial on eight genotypes conducted at Akola (Maharashtra) during kharif, 1981 in "All India Coordinated Project (Groundnut)", Punjabrao Krishi Vidyapeeth, Akola.

The study revealed that number of pegs and number of flowers per plant, though showed positive and significant genotype correlations with percentage of immatured pods in groundnut, had no positive association with end character but their negative and high direct effects were suppressed their negative indirect effects through span of flowering. Only span of flowering showed positive and high direct association with percentage of immatured pods which could not be seen through its negligible total correlation because of its high positive correlations with above two characters.

80. Survivorship for some Breeds of Bovines in Punjab
By U.G. NADKARNI, T.B. JAIN AND RAMESH KUMAR
IASRI, New Delhi

Survivorship measures viability of the species in different environments. The survivors (l_x) to any age x from a given cohort depend on the mean length of life of the species. For comparison of survivorship of bovines of different breeds, percentage deviations from mean length of life are first obtained. The curves are drawn for survivorship against these percentage deviations for Hariana, Sahiwal and Non-descript cattle and Murrah, Nili and Non-Descript buffaloes in ICD (Amritsar) and non-ICD (Ferozepur) areas of Punjab. It was found that except in the case of Non-Descript cattle of either sex in ICD area the curves were of positively skew rectangular type.

81. On some Growth Models for Poultry Produce
By BHAGWAN DASS AND U.G. NADKARNI
IASRI, New Delhi

To study the variation in egg production over time, the data collected by the IASRI during 1969-70 for the project "Estimation of Cost of Production of Poultry and Eggs" in and around Delhi are analysed. Sixty seven farms were first classified into three groups on the basis of productivity. Analysis of variance over these groups and seasons for non-orthogonal data for egg production and feed in take of 100 layers was carried out and it was found that between groups, between seasons and interaction sum of squares were significant at 1% level in case of egg production and non-significant in case of feed intake. Different growth curves viz, linear, quadratic, cubic and Wood's fit for yearly and seasonal data were fitted for each group of farms by taking the egg production of 100 layers as a dependant variable and time (Weeks) as an independent. Growth curves were then also fitted for data of each farm. The results of these fitted curves are further discussed.

82. Linear Programming Techniques for Balanced ration of Poultry and Pigs
By U.G. NADKARNI, L.B.S. SOMAYAZULU AND
C.D. RAVINDRAN
IASRI, New Delhi

Linear programming techniques help in finding the optimum combinations of a large number of feeds to provide set of nutritional levels in feeds for animals. In this study, these techniques are used for obtaining the rations for poultry and pigs. Nutritional levels

for animals of different age groups are first indentified in terms of TDN, DCP, protein, energy and dry matter. Different objective functions for cost on feeds were formulated taking into consideration the alternative combinations of feeds which may be tried in different regions as per their availability. Optimum solutions under the different sets of restrictions to attain the nutritional levels identified were obtained for four categories of poultry birds viz. chicks, young birds, adults and broilers and four categories of pigs, *viz.* creeper, young pig I, young pig II, adults. Sensitivity of the optimal solutions to minor changes in price levels were studied and toassess the extent of changes in prices, linear and quadratic models were fitted to annual prices of important food grains and groundnut cake which form part of the feeding material for these species.

83. Labour Utilisation Pattern for Dairying
BY S.B. AGARWAL AND K.N.S. SHARMA.
NDRI, Karnal

The data for the present study were taken from the survey conducted during 1972-74 by NDRI to study Bovine development and milk production. The data on labour utilisation pattern in different seasons from 1807 sample households was collected by oral enquiry. Labour input was mainly by the family labour which accounted for 90%. On an average a family devoted about $6\frac{1}{2}$ hours a day to dairying. A paid labour, on an average, devoted about 45 minutes per day to dairying. The major portion of labour input (75%) was for feeds to animals which included, feeding, grazing, bringing fodder etc. On an average a family labour devoted about 156 man-minutes per milking animal per day, It was observed that about 86 man-minutes were devoted to produce one kg. of milk. Women labour contributes a lot to-wards dairying entrerprise, the contribution of men and women being more or less of the same order.

84. A Study for Comparing the Efficacy of Artificial Insemination vis-a-vis Natural Service.
BY K.C. BHATNAGAR, BHUAPL SINGH AND S.B. AGARGAL.
NDRI, Karnal.

An attempt has been made to compare the economic efficiency of A.I. as compared to natural service. The first agency to report the cost of natural service was the Evaluation Committee on Key village Scheme appointed by the Government of India in 1961 Then a number of research workers and scientists worked out the cost of A.I in their respective areas of study. These workers found that one bull, on an average, performs 100 services per year. The rate

of conception was observed to be 60% in case of natural service and about 34% under A.I.

In the present study the cost of A.I. per conception was found to be Rs. 84.82 and the corresponding cost of natural service as Rs. 82.02. It is generally seen from all the studies that the Cost of A.I. is slightly higher or at most equal to that of natural service. This is perhaps due to the fact that the maximum share of total cost was fixed cost. Cost of administering of semed was relatively much higher. The losses incurred were also reported to be high. It was further observed that if the efficiency of utilization of total semen produced by a bull during a year increased,, the cost per conception would go down much less than the cost of a natural service.

85. Frequency Distribution of Plot yields in natural Grassland in Nilgiri Hills.

By B.M.C. AGARWAL AND RAM BABU
Central Soil & Water Conservation Research & Training Institute, Dehra Dun,

For field experiments in natural grasslands in Nilgiri hills, Ram Babu *et al* (1980) recommended plots of 8 m^2 to 12 m^2 with the shape elongated along the slope. However, the frequency distribution of yields from such plots has not been tasted for normality. An attempt has been made to find out the nature of the frequency distribution of plot yields of various sizes and shapes from such lands. For this purpose the grass yield data recorded in the uniformity trial conducted in the Nilgiri hills was utilized.

The results indicate that there is a minimum plot size below which the assumption of normality is not followed in such lands. In the present study, the frequency distribution of yields from the plots of 8m^2 to with 2:4 and 4:2 plot shape and 12m^2 with 3:4 and 4:3 plot shape followed the assumption of normality: For field experiments in natural grasslands in Nilgiri hills, the plot of 8m^2 to 12m^2 was recommended and to satisfy the necessary conditions of normality for vaild statistical interpretation, the minimum plot size should also be taken around 8m^2.

86. Poverty Line and Fluid Milk Consumption in a Rural Area

By B.C. SEXENA, H.P. SINGH AND KRISHAN LAL
IASRI, New Delhi

The effect of urban milk supply schemes over a period of time in respect of fluid milk consumption specially in two income groups based on the concept of poverty line, has been examined. Data collected at two points of time *viz*. 1975-76 and 1979-80 in the

survey, "Impact of milk supply scheme on rural economy in milk collection areas of Madhavaram Milk Supply Scheme, Chingleput, Tamil Nadu", are utilised. The data on mode of utilization of 477 households collected on the two occasions was classified into two income groups *i.e.* the one falling below poverty line and the other above poverty line according to their gross income being less than or equal to Rs. 300/- p.m. and more than Rs 300/- p.m. respectively.

It is seen that fluid milk consumption in households below poverty line was 50g. and 100g. in commercial and noncommercial households respectively on earlier occasion. It reduced to 20g and 90g. in these households on the later occasion. In the households above poverty line, the per head fluid milk consumption on both the occasions was roughty 2 to $2\frac{1}{2}$ times higher than those below poverty line.

87. A Critical aspeet of the rural employment
BY H.P. SINGN, B.C. SAXENA & S.P. VERMA
IASRI, New Delhi

A number of rural development programmes like I.R.D.P., N.R.E.P., etc. are currently in operation for generating employment potential in the rural areas. As a result of these programmes, an increase in employment potential is also expected in various sectors. The present article endeavours to measure the average number of hours spent per week by different categories of workers belonging to various types of families engaged in different types of occupations. The estimates were obtained at two points of time from the data collected in the milk shed areas of Madhavaram Milk supply Scheme, Chingleput (T.N.) under the bench mark survey (1975-76) and repeat survey (1979-80) conducted by I.A.S.R.I., New Delhi. Further the employment generating indicators have also been suggested for estimating the changes in average time spent by a worker over the two occasions.

88. A study on use of Tractor and Bullock Labour in cultivation of Vegetable crops in Delhi
BY JAGMOHAN SINGH & D.C. MATHUR
IASRI, New Delhi

Vegetable Crops are of short duration and labour intensive. Various intercultural operations are required for their cultivation apart from ploughing operation. Vegetables are grown, generally in small fields where the use of tractors is not only uneconomical as compared the Bullock labour but difficult as well. The method of ploughing the fields, by tractor or bullocks in case of cultivation of

vegetable crops needs some study. This aspect has been studied in this paper on the basis of data from the survey to estimate the cost of cultivation of vegetable crops in rural area of Delhi during the year 1978-81.

89. Evaluation of bullock labour—an exact method.

BY K.C. RAUT AND K.V. SATHE

IASRI., New Delhi

One of the major components of cost of cultivation of crops is the cost on bullock labour. The extent of bullock labour utilised in cultivating a crop and the prevailing hiring charges of a pair of bullocks are utilised to work out the cost on bullock labour. This obviously is a subjective method as most of the farmers own bullocks for agricultural operations and hiring is rare. An attempt has been made to suggest an objective method to obtain the cost on bullock labour. This method can be utilised where the data on all the necessary inputs and output of crops, maintenance cost of bullocks and their utilization are available.

90. Repeatability of Wool quantity and quality in Grozney Merino sheep

BY V. MANI, I.M. RODRICKS, C.K. BHUVANAKMUAR

Sheep Breeding Research Station, Sandynallah, Nilgiris

Estimate of co-efficients of repeatability for greasy fleece yield, fibre diameter and staple length of farm bred Grozney Merino sheep were found to be 0.404, 0.295 and 0.639 respectively. Ninetyfive percent of confidence limits for the above repeatability co-efficients were also obtained. Staple length was found to be the highest repeatable character while fibre diameter the least. The estimated values of the co-efficients of repeatability may be considered in a selection programme of Grozney Marino sheep in which greasy fleece yield, fibre diameter and staple length are the traits for selection.

91. A method for estimation of Endogenous urinary Nitrogen from the Nitrogen balance experiments in Buffaloes

BY V.N. BHARGAVA, G.C. MISRA AND SUBEDAR SINGH

Banaras Hindu Universiry, Varanasi

Endogenous urinary nitrogen (EUN) forms an important prerequisite for estimation of protein requirement for miantenance by the factorial method. However, its determination in ruminants by actual experimentation poses problems. Consequently, possibility of estimating EUN from the daily urinary nitrogen excreation at different levels of nitrogen intake in buffaloes has been explored. Data on total nitrogen intake, total digestible nitrogen consumption and corresponding excretion of urinary nitrogen, all expressed in

gms per 100 kg body weight per day from three sets of seven nitrogen metabolism trials at five levels of nitrogen intake, were collected. Each trial consisted of three identical groups of eight buffaloes each, fed at three levels of protein intake. Differences in the urinary nitrogen excretion was found stastistically significant due to significant differences in total nitrogen intake and digestible nitrogen consumption. On pooling the data of all the trials, highly significant correlation coeffieients of urinary nitrogen excretion with total nitrogen intake ($r=0.50$) and digestible nitrogen consumption ($r=0.63$) have been obtained. Assuming daily urinary nitrogen excretion (Y) as dependent variable and nitrogen intake (X_1) and digestible nitrogen consumption (X_2) as independent variables, linear regression equations fitted were : $Y=1.68+0.14 \, X_1$ and $Y=2.01+0.32 \, X_2$ respectively. The estimated value of EUN has worked out to 2.01 gm/100 kg body weight which compares well with the actual value of 1.97 gm/100 kg body weight per day.

92. Characters responsible for proportion of filled seeds in Sunflower

BY D.K. WANKHADE, M.K. KHERDE AND R.K. KOLHE
Punjabrao Krishi Vidyapeeth, Akola

Within five years of introduction during 1970's of Sunflower as a substitute oilseed in Vidarbha, it was observed that cultivators were losing interest in the Sunflower. The probable reasons for decrease in area under Sunflower since 1975 might be defective seed setting and seed filling. The present study was, therefore undertaken to assess characters affecting the seed filling of the Sunflower.

The study revealed that in case of Surya, area of the head of flower and in case of BSI-1, height of the plant were observed to be influencing the percentage of filled seeds. The percentage of filled seeds of Surya variety dicreases with the increase in area of the head where as percentage of filled seed of BSH-1 hybrid increases with the increase in height of the plant. The selected characters, namely, height of the plant, area of the head, total number of seeds and 100 seed weight were not and observed to the influencial on filled seed percentage of Modern and EC-68414 varieties.

93. Optimisation of Fertiliser requirement under different Soil-Fertility Constraints using Linear Programming technique.

BY G.R. MARUTHI SANKAR
All India Co-ordinated Soil Test Crop Response Correlation Project, ICAR, Hyderabad

The Dantzig's Simplex procedure for solving a Linear Progamming problem was used in the optimisation of fertiliser N,P and

K requirement under a linear model situation. The liner model was treated as an objective function with yield (Y) as a dependent variable and was regressed in terms of soil and fertiliser N,P and K nutrients as a set of independent variables. The soil fertility constraints were postulated in terms of the soil and fertiliser efficiencies under the six different methods of experimental plot-selection. The optima derived under the linear model situation were found to satisfy the linear objective function and the soil-satisfy the linear objective function and the soil-fertility constraints. Further, it was found that while the optima based on a linear model were nearer to the actual levels of fertiliser upto which there was response obtained in the experiment, the optima derived under the curvilinear model were high .

94. Tests of Significance of the Variations in Estimates of Soil and Fertiliser Nutrient Efficiencies

By G.R. MARUTHI SANKAR, M. VELAYUTHAM,
K.C.K. REDDY, AND K.R. SONAR,
All-India Co-ordinated Soil Test-Crop Response Correlation Project, Hyderabad

Soil and fertiliser nutrient efficiencies can be calculated from soil test-crop response field experimental data. The different ways of selecting suitable experimental plots and estimating these efficiencies were compared from the soil test-crop response data of Robi Sorghum experiments conducted over three seasons in vertisol at Rahuri, Maharashtra. The three methods of estimation compared were (1) conventional deduction method, (2) simultaneous estimation method and (3) least-squares method. Six methods for the selection of suitable plots were adopted for estimating the efficiencies by each of the three methods. There was no significant difference in the estimates between the six methods of selection of plots. There were significant difference, in the estimates derived by the three methods. The estimates derived under least squares method were significantly different from these derived by the other two methods. There was no significant difference between the estimates derived under conventional and simultaneous methods except for fertiliser K efficiency. The average efficiency of soil available nutrients for Rabi Sorghum in the vertisol is 32, 60 and 16% for N, P and K respectively. The efficiency of fertiliser N is 35% and of fertiliser P is 31%. The efficiency of fertiliser K was variant dependent on the method, being 33%, 55% and 84% by the least squares, simultaneous and conventional deduction method respectively. The relative merits of estimation are discussed.

95. Studies on Variability in Cattle Population in Maharashtra State
By N.Y. Palimkar and A.D Deshpande
Marathwada Agricultural University, Parbhani

The study on variability on cattle population in Maharashtra is undertaken on the basis of sample means & coefficient of variation on regional & census basis (1961, 1966 & 1972). The dissimilar trend in variability are observed for different characters on regional basis, where as consistant results of non-variability were observed on census basis, indicating the zero growth in cattle population of Maharashtra State.

96. Feasibility of Dairy Programme in a Tribal Area of Andhra Pradesh
By V. Maheswara Rao
Andhra University, Waltair

The study was conducted in five tribal villages in Visakhapatnam district of Andhra Pradesh pertaining to the year 1979-80 and brought out that there is a direct relationship between farm size and size of family, literacy status and feeding concentrates to stock. Feed emerged as a major item of cost of maintenance which accounted for about 80 per cent of the total maintenance cost. Labour employed in dairy entreprise consists of only family labour which formed about 15 per cent of the total maintenance cost. Cost per litre of milk production was the lowest (Rs. 1.17) an small farms and the highest (Rs. 1.37) on landless farms. Net income from dairying is positive on all the categories of households though it is the lowest on landless. Knowledge about low cost improved dairy technology, livestock management, feed and pasture improvement need to be disseminated. Since the land holdings are small, community and or village owned hill slopes should be used to raise fodd o trees and grasses to supplement the fodder requirements of the animals.

97. A Note on Determination of Consumer Scales
By Bhupal Singh, P. Kumar* and R.K. Patel
N,D.R.I., Karnal

A modification in the Singh-Nagar (1973, 1978) iterative procedure has been proposed for estimating the equivalent adult consumer scales. The Singh-Nagar (1973) iterative procedure, which is essentially a modification of the Prais and Houthakker (1955) method has the advantage that it enables us to use several functional forms of Engel curve without arbitrarily fixing value of any parameters. Muellbauer (1975) pointed out that the Singh-Nagar approach, like

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that of Prais-Houthakker's, suffers from a crucial identification problem and suggested that if equivalent adult scales could be a priori specified for at least one 'good', then consumer scales for all other goods could be identified.   Therefore, the problem is to determine the specific scales for each age-sex group for at least one 'good'. Singh and Nagar (1978) argued that one could easily estimate the specific scales for a commodity having zero or nearly zero income elasticity of demand.   In real world, however, it is difficult to find a 'good' with zero income elasticity of demand and therefore, the Singh-Nagar (1978) modified procedure will also not be of much use for determination of accurate consumer scales.   In this paper a simple alternative has been suggested which involves data-collection, at the survey stage, on consumption of at least one item (like milk) for individual members of the sample households.

98.   Nutrient Status of the Soils of Gujarat

BY J.H. PATHAK
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AND
R.M. PATEL
Gujarat Agricultural University, Anand

The nutrient status of the Soils depends upon the soil characters.   Efforts have been made to obtain the ready picture of the overall soil fertility of the districts/talukas of Gujarat State.   The results of about 3.48 lakh soil samples analysed over a course of three years (1975-77), have been used to work out district/talukawise indices for soil reaction (pH), salt content (EC), available N, P and K by using the method suggested by Parker *et. al* (1951).

pH :   The soils of 10 districts were normal, those of 8 districts were alkaline while only one district had acidic soils.   As regards talukas, 54.89% of the talukas were found normal in reaction, while 44.57% were found alkaline in nature.   Only one taluka had acidic soils.

Electric Conductivity (EC) :   As many as 14 districts were found to possess normal salt content.   As regards talukas, 86.95% of the talukas possessed normal salt content in their soils while 7.60% and 5.45% of the talukas possessed injurious and harmful salt content in their soils respectively.

Fertility Status :   The districts of the state have been grouped into five groups on the basis of rating of the districts into low, medium and high categories with respect to available N, P and K.   As regards talukas, 93 of the 184 talukas of the State have had low N and 99 talukas have had low P.   Medium N was found in 71 talukas while

it was low in 20 talukas. Medium and high P was found in 80 and 5 talukas respectively while the soils of almost all talukas (178) were rich in K.

99. On Asymptotic Power of Anova test Procedures in a conditionally specified Random Model
By M.A. ALI
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The present paper is concerned with the derivation of the asymptotic power of 'sometimes pool', 'sometimes switch' and 'never pool' test procedures in a two-way classified random effects model with equal number of cell observations. The efficiency of the sometimes procedures has been compared with that of the never pool test using Pitman criterion.

100. On Resolvable incomplete Block Designs
By A. DEY
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AND
LALIT KISHORE
P.A.U., Ludhiana

It has been shown in this paper that an affine resolable Balanced Incomplete Block (BIB) design D contains two-Group-Divisible (GD) designs D_1 and D_2. The design D_1 is semi-regular while D_2 is disconnected. In fact, the blocks of D_2 form the groups for both the designs D_1 and D_2. However, $\overline{D_2}$, the complement of D_2 is connected under certain conditions and further, each pair of blocks of $\overline{D_2}$ intersects in a constant number of treatments, *i.e.* $\overline{D_2}$ is linked block. Hence the dual of $\overline{D_2}$ is a BIB design. Also, the solution of D_1 is necessarily resolvable.

101. Construction of Group Divisible second order Rotatable Designs through balanced incomplete Block Designs
By K.C. CHENNA RAYUDU,
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V.L. NARASIMHAM
Nagarjuna University
AND
P. RAMACHANDRA RAO
S.V. University (Tirupathi)

Das and Dey (1967) have constructed Group divisible second order rotatable designs (GDSORD) with the help of Balanced incomplete block designs (BIBD) with $r < 3\lambda$. No result is available

in the literature for the construction of *GDSORD*, with *BIB* Designs with $r > 3\lambda$. In this work a new method of construction of *GDSORD* using *BIBD*, with $r > 3\lambda$ is suggested and in this connection a new theorem is established and also an important corollary is obtained.

102. Estimation of Genotypic and Environmental variations in Banana Crop

BY P. NARAIN, P. N. BHARGAVA. L. K. GARG AND P. S. RANA

IASRI., New Delhi

It is well known that the variability in the yields of plants is influenced by its genotype and environment. With this end in view a study was conducted to estimate the relative contribution of genotype and environmental variations to the total variation in banana plants. The data considered for the purposes pertained to the Barsai variety of banana from village Nasirabad (Jalgaon) under the uniformity trial experiment plannned by this institute in June, 71. The data consisted of 480 plants in 24 rows of 20 plants each. The spacing between rows and plants was 150 cms. Yield in terms of number of fruits per tree was considered for the study. Groups of different sizes were formed by combining the yield of adjacent plants. Genotype and environmental components of variation between groups are estimated by filling the additive model $W = G + Ex^{1-b}$ and with in the group components of environmental variation are estimated by $\frac{x}{x-1}(1 - x^{-b}) E$ where W, G, E, x and b are the mean sums of squares between groups, genotypic and environmental components of variation, size of the group and a constant lying between zero and unity respectively. It is observed that contribution of genotypic and environmental components of variation to the total variation between groups are in the ratio of 3 : 2 and within group components varies between 4 : 1 and 5 : 2 approximately for different groups sizes. It is inferred that there is a scope for attempting a selection on genetic basis and due consideration should be given while planning an experiment on banana.

103 Ortho-Balanced Block Design

BY G. M. SAHA AND B. K. SAMANTA

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A connected block design has been called *C*-design by Saha (1975) if it satisfies $M_0^2 = \mu M_v$ for some positive constant $\mu < 1$. A sufficient condition for a connected block design to be a C-design as given in Calinski (1971) is shown to be necessary as well in this note.

This gives a characterization of a C-design which immediately shows that such a block design is really an Ortho-Balanced Block design (*OBBD*). It is pointed out here how an *OBBD* arises naturally from a randomised Block design after certain observations get lost. This led to the constructions of two classes of *OBB* designs.

104. Fitting Poisson Distribution to Incidences of Conception under the Artificial Insemination in Crosbred Cattle
By R. SRIVASTAVA AND O.B. TANDON
ICAR, New Delhi

An exercise to test the fit of poisson distribution to Artificial Inseminations and resulting conception in crossbred cattle at Jabalpur unit of All India Coordinated Research Project on Cattle was made. The fit brought out that λ values in such population are of the order of 0.82/0.92. The chi-square test showed that the Poisson distribubution can be appropriately fitted to describe this trait.

105. Pairwise balanced, Semi-regular & regular group of divisible designs
By KISORE SINHA,
Birsa Agricultural University, Ranchi

A method of constructing pairwise balanced designs and semi-regular group divisible designs is given. A list of such unknown regular group divisible designs is also presented.

106. Production performance of crossbred and indigenous cows under field conditions in a hilly area
By SHIVTAR SINGH, K.C. RAUT AND J.P. JAIN
IASRI., New Delhi

In this paper production characteristics of cows maintained under rural management conditions based on primary data collected in the course of a methodological sample survey investigation conducted by the Indian Agricultural Statistics Research Institute, New Delhi in Palampur area (H.P) during 1981-83 have been studied. The study has been confined to first calvers to avoid the effect of selection. The age at first calving of a crossbred cow was 50.2 months as against 64.2 months for a non-descript cow. The crossbred cows yielded on an average 1473 kg per lactation which is three times the yield of an indigenous cow. For both the species of cows although calvings were unevenly distributed in different seasons, the effect of season of calving on lactation length and lactation yield was found insignificant. Further it was seen that the performance improved with the increase in the level of exotic inheritance.

107. Construction of M-Group divisible second order Rotatable Designs through a pair of pairwise Balanced Designs

BY P.R. RAO
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AND

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Sri Venkateswara University College, Tirupati

A new method of construction of m-Group divisible second order rotatable design through $(m+1)$ pairwise balanced designs has been suggested. This forms a generalisation of Rao, Narasimham and Sastry (1983) method of Constructions of *GDSORD*.

108. On the analysis of one-way classification with unequal group variances

BY B. SINGH
CIRG, Makhdoom, Farah, Mathura

The usual analysis of variance F-Test for equality of means from several univariate normal population is not robust when the group variances are unequal (Box, 1954). For such situations various approximate methods have been suggested by several authors. An exact method for analysis of one-way layout under balanced situation is obtained using Hotelling T^2 when group variances are unequal. The expression for the test-statistic to be used is simplified in a computable form. This method can also be used to compare the approximate methods available in the literature to all their suitability for unbalanced situation.

109. Estimation of population men in skewed or symmetric Populations.

BY SURENDRA K. SRIVASTAVA AND K.C. GOYAL
Punjabi University, Patiala and H.A.U. Hissar

It is well known that use of auxiliary information on variables other than the variables of interest, population parameters and its shape increases the efficiency of the estimation procedures. Searls (1964) proposed an estimator of population mean $\overline{Y}$ when population coefficient of variation $C_y(=S_y/\overline{Y})$ is known. Srivastava (1974) extended his idea further and defined two estimators which he

obtained by substituting C_y^2 by its consistent estimators in the Searls' estimators. His estimators are more efficient than mean per unit if the study variable is positively skewed. The estimators proposed by Upadhyaya and Srivastava (1976) attain minimum *MSE* for negatively skewed populations. These are better than mean per unit for symmetric populations also. Recently Sahai and Ray (1979), Srivastava and Banarsi (1982) proposed estimators for symmetric populations. Zenkins *et. al.* (1973) defined 'root estimators' for positively skewed population. However, it is observed that neither baises nor *MSE*'s of these estimators converge to zero when sample size n is made large. Hence these are inconsistent. Moreover they require knowledge of number of population parameters information on which may not be available in practice. All these estimation procedures uses a priori information on the shape of the distribution of the study variables only. They do not utilize information on auxillary variables when it is available. In this paper we propose estimator for population mean when x, the auxiliary variable is negatively skewed and y, the variable under study is positively skewed or both are symmetric.

110. Modified Ratio Estimator

By N.M. PATEL

Sir P.P. Institute of Science, Bhavnagar (Gujarat)

A modified ratio estimator is suggested using the prior knowledge about the coefficients of correlation and $\theta = \dfrac{C_y}{C_x}$ where C_x and C_y are coefficient of variation of variates x and y. The modified estimator is shown to be more precise than the sample mean, the usual ratio estimator and the products estimator under *SRSWOR*.

111. Trends in Area, Production and Yield of Jute in India

By A.K. VASISHT AND VED PRAKASH

IASRI, New Delhi

A study on performance and growth of jute culivation was made during the period 1963-64 to 1981-82 in the states Assam, Bihar, Tripura, Uttar Pradesh and West Bengal. It was found that there had been decline in the area under jute over the period of nineteen years at all India level. The area under the crop has decreased in all the states unde consideration except the states of West Bengal where the state has recorded a slight increase. The production of jute has gone down in all the states except West Bengal where it has

shown a growth rate of 2.2 percent. Wide variation in jute pro-
duction were observed from state to state. All the states except
Bihar and Uttar Pradesh have recorded an improvement in the
productivity of the crop. The rate of increase in productivity is
slow. At all India level, the annual increase in area, production
and productivity of jute cultivation was 0.3, 1.0 and 0.7 per cent
respectively.

112. A Comparative Study of Livestock Developments in Akola District (Maharashtra State)

BY R.K. KOLHE AND D.V. RATNALIKAR
Punjabrao Krishi Vidyapeeth, Akola

The share of agricultural sector in the national income is
almost half and out of the total share in agricultural sector, 18
percent is directly contributed by the livestock population. The
overall picture of the livestock development in the district as a whole,
and at the taluka level can be represented in terms of the vorious
indicators such as livestock density per square kilometer of the
geographical area, bovine density per square kilometer of the area,
working bullock population per square kilometer of gross cropped
area, cows and buffalloes in millk per thousand persons and bovine
population per hectare of permanent pasture and grazing land etc.

From 1961 to 1966 and 1972 to 1978, the indicators show in
general an increase in their value but they recorded a decrease
for the period from 1966 to 1972. The position of Mangrulpir and
Washim talukas is comparatively better with respect to all the
indicators, Akola taluka which showed lesser density in respect to
almost all indicators, has however shown some what better position
in case of the density of cows and buffalloes in milk per thousand
human population, which may be attributed to the urbanization of
the area.

113. Land Utilization Pattern of Akola District—A Case Study.

BY V.M. KORANNE AND D.V. RATNALIKAR
Punjabrao Krishi Vidyapeeth, Akola

Land is a very important and peculiar factor of production
Being inelastic its utilization deserves a carefull study. An effort
is made in this study to analyse the Land Utilization Patterns of

Akola District for the period from 1953-54 to 1975-76, with a veiw to explore the areas for better allocation to different land uses, and to study the behaviour and variability of the area under different land use categories.

114. Statistical Parameters for Crop Planning in rain fed Agriculture

BY P.N. BHARGAVA AND ASHA SAKSENA.

IASRI, New Delhi

In India, around 75% of the gross cropped area is cultivated under rainfed conditions, and the production from these areas very much depends upon the vagaries of weather. The productivity of these areas is low and they contribute to the total foodgrain basket of the country to the extent of about 42 to 45%. In these areas basically the coarse grains are grown and the total supply of fibres namely cotton comes from these areas. For the efficient utilisation of rain water, it calls for the study on behaviour of rainfall and other related aspects like wet and dry spells during the crop growing season so that the cultivation practices for a crop could be developed in such a manner that the important crop operations could be avoided during the period when the water availability for the crop is very much uncertain. The Institute has carried out some investigations on this aspect by utilising the data on rainfall and crop productivity for some crops in Jalgaon and Jamnagar and developed some suitable statistical parameters like the amount of assured rainfall for different crop growth periods, pattern of wet and dry spells, expected number of wet and dry days, the estimates of runoff and the probability estimates for occurrence of drought in relation to a particular crop. The method of working out these parameters and their utilisation for crop planning in an area as discussed in the present paper.